

JUNE, 1924

Railway Engineering and Maintenance

Weed-free Tracks At Half the Cost of Hand Weeding

50 to 75 miles of track can be weeded in a day with "HERBICIDE" at an average cost of \$50.00 per mile. One treatment lasts for the season.

\$100.00 per mile for hand weeding is low, and it takes several hand weedings to keep the tracks free of weeds during the growing season.

We offer—a 50% saving in first cost—a clean track for the season—to release labor for essential track work.

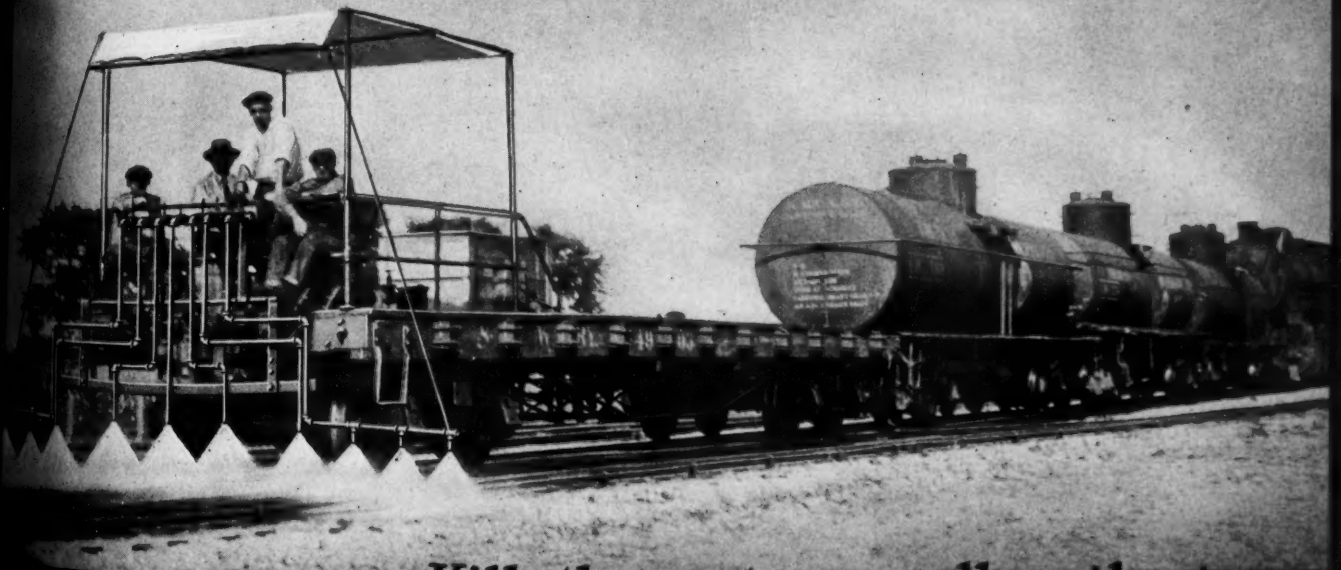
Let us submit an estimate on the cost of weeding your track.

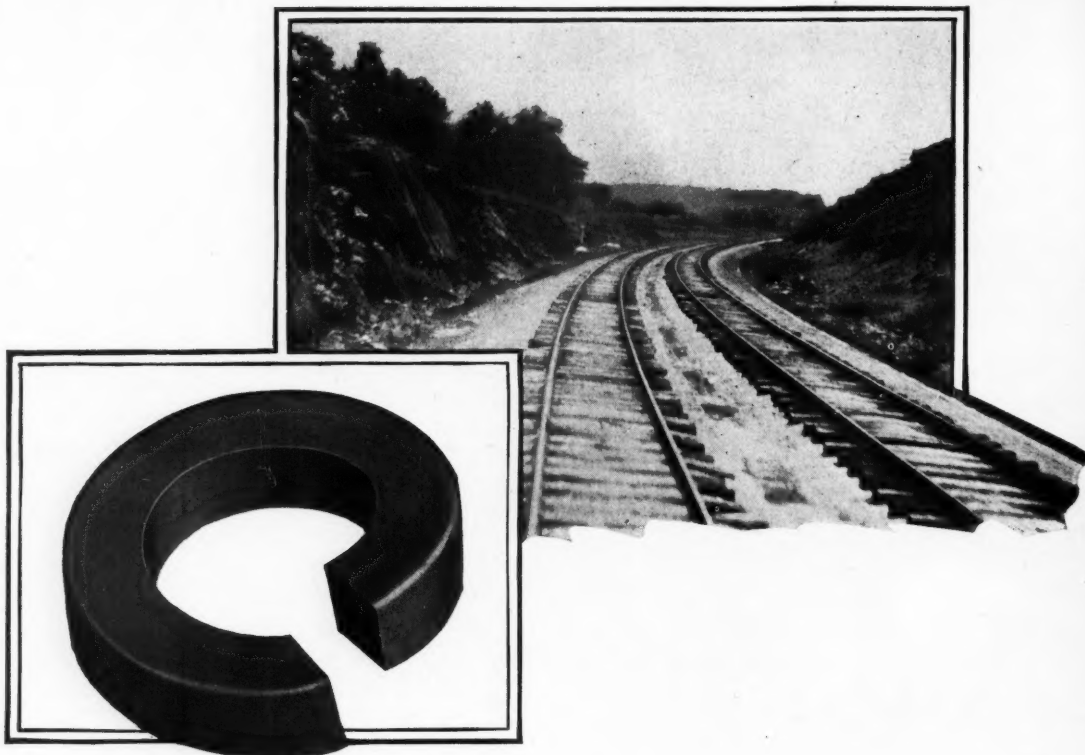
Reade Manufacturing Co., 135 Hoboken Ave., Jersey City

Works: Jersey City and Chicago

"HERBICIDE"

The Weed Exterminator





HY-CROME Nut Locks should not be confused with the ordinary lock washer of short time service.

Hy-Crome was designed and is manufactured to not merely fulfill but surpass the foremost demand for dependability.

Because this nut lock measures up to the needs of today in track joint security, it has gained world wide confidence among the men who are responsible for track joint efficiency and economy.

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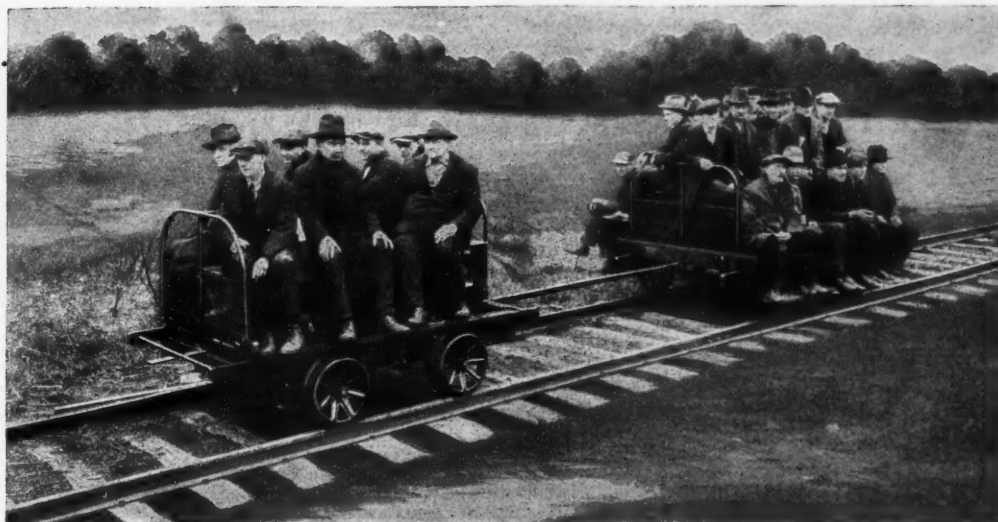
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Nut Locks

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POWER

makes them popular

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Mudge & Company

**Manufacturers—Railroad Equipment
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In Sludge Removal Alone

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"A similar test was made with a conical-bottom treating tank 28 feet in diameter. After 60 hours' operation, during which time 1,000,000 gallons of water had been treated, and the sludge deposit amounted to over 4,000 pounds, it was found that 2,300 gallons of water was sufficient to remove the sludge completely. The practice on the Illinois Central is to wash the sludge out twice a day and the water required for this purpose rarely exceeds 1,200 or 1,500 gallons daily, while to do the same work in a flat-bottom tank would require 8,000 or 10,000 gallons, a conservative estimate of the amount of water saved daily being 7,500 gallons which, at the low rate of 15 cents per thousand gallons for pumping and treating means an annual saving of over \$400 per year or six per cent on an investment of over \$6,500."

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Dam and Spillway of DuQuoin Reservoir, Illinois Central

Railway Engineering and Maintenance

Formerly the Railway Maintenance Engineer

Vol. 20

June, 1924

Number 6

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How to schedule track work?
How corrugated culverts act under load?
How to design an automatic pumping plant?
How to protect a river bank in an emergency?
What it would cost to separate all grade cross-
ings?

Answers to these and other practical questions
will be found elsewhere in this issue.

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THE IDOL TRACK LINER AND JACK



Illustration No. 1



Illustration No. 2

Illustrations numbers 1 and 2 show the proper placement of Liners to line frogs. Place three Liners against outside rail in direction of throw, two Liners against frog and two Liners against inside rail. The work of lining can be done with one-third the number of men required when using lining bars. This work usually takes a greater period of time with 15 to 21 men using lining bars than is taken by 7 men when using Idol Track Liners.



Illustration No. 3

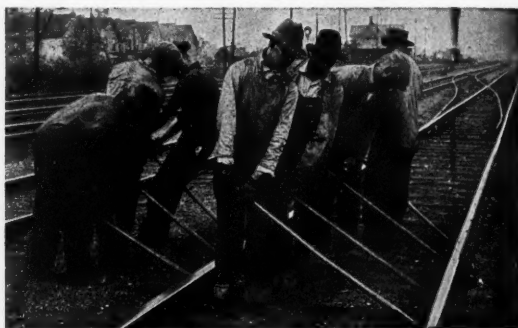


Illustration No. 4

Illustrations numbers 3 and 4 show the lining of ordinary track. Set two Liners against outside rail in direction to be lined, and one against inside rail.

Illustration number 3 shows three men doing the same work with Idol Track Liners as was formerly done by seven to nine men with lining bars. The seven men using lining bars

shown in illustration number 4 could not line the track; the three men with Liners moved the same track easily, without digging out the ballast at the end of the ties. When section crews are reduced to three men, all ordinary track can be lined without waiting for the organization of full forces, and without the doubling of section crews.



Illustration No. 5

THE IDOL TRACK JACK No. 1

Illustration No. 5 shows Idol Track Jack No. 1, which weighs only 26 pounds.

Illustration No. 6 shows man carrying Idol Track Jack, wrench, pick and shovel with ease.

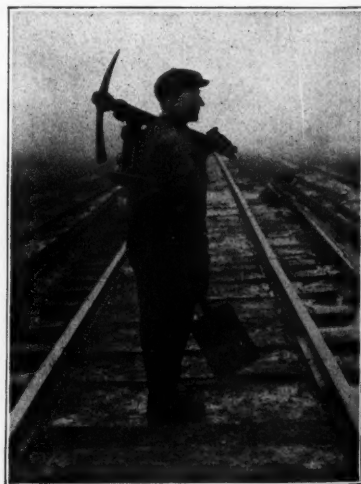


Illustration No. 6

THE IDOL TRACK LINER CO.

Railway Labor Saving Devices

717-723 South Wells St., Chicago, Ill.

F. Hackmann, President and Mechanical Engineer
Thos. D. Crowley & Co., Sales Agents

J. J. Franzen, Secretary and Treasurer
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**The Car with the
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The Extension Side Dump Car solves the problem and solves it rightly.

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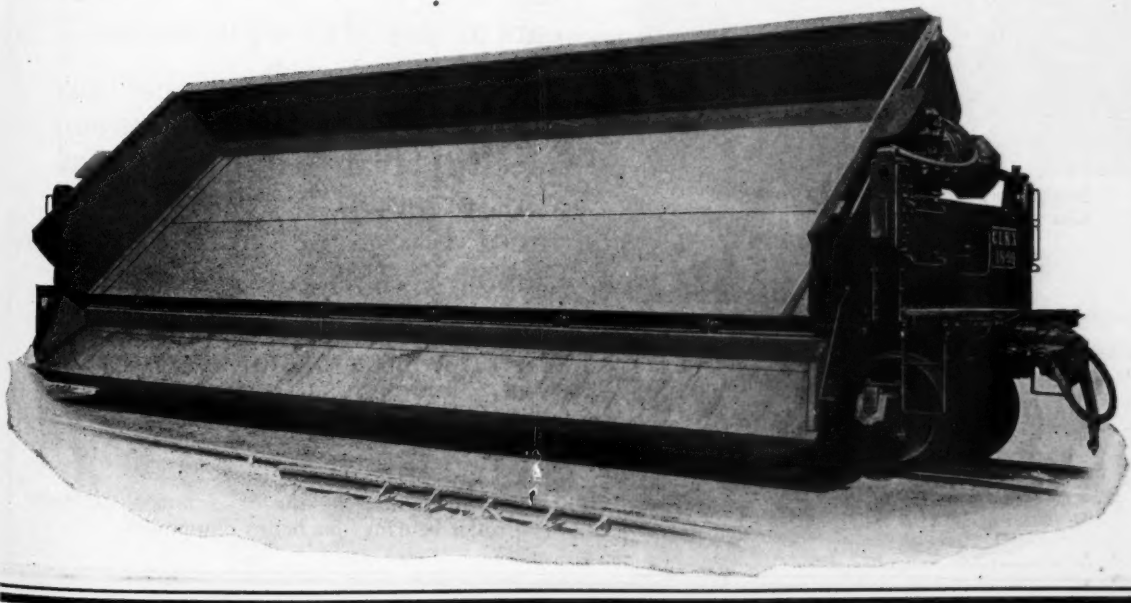
The Extension Side Dump Car is truly a labor saving device with an efficient and conscientious service behind it. It saves and it serves as it pays for itself.



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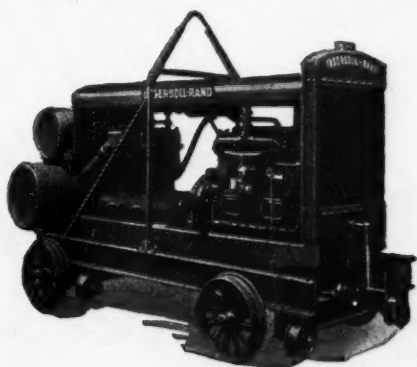
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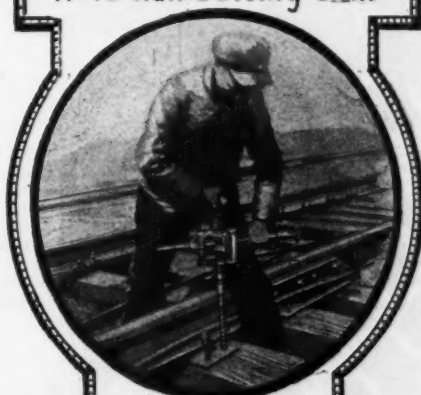
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No. 7 of a Series



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Traffic: Transcontinental freight and passenger.

Installation Data: A 24 in., 12 ga. ARMCO Culvert, under 5 ft. fill of sandy soil. Installed 1910. Under traffic 1912.

Condition: Evidently perfect. No distortion or settling visible. Galvanizing intact. Photographed and inspected May 19, 1922.

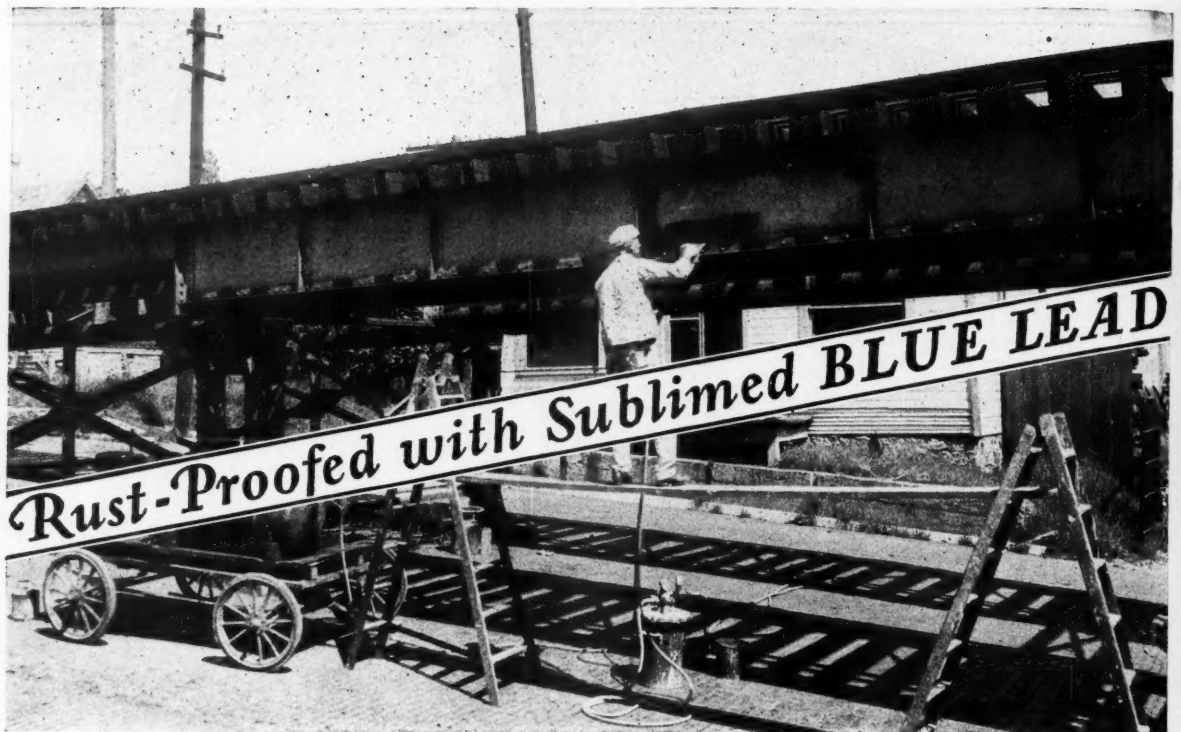
Remarks: Inspection of culvert under comparatively light sandy fill of this nature when heavy train is passing reveals the need for an elastic structure at such a location.

There is a manufacturer in almost every state and in Canada, making Culverts, Flumes, Siphons, Tanks, Roofing, etc., of genuine, rust-resisting Armco Ingot Iron. Write for full information and nearest shipping point on products in which you are interested



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Why Seven More Railways Adopted Sublimed Blue Lead in 1923



Send for "Fighting Rust with Sublimed Blue Lead" — a Rust-Proofing Manual



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The photo above shows graphically one of the reasons for the general spread of the use of Sublimed Blue Lead in Oil as a rust-proofing pigment. The painter is applying Sublimed Blue Lead in Oil to the Fourth Street Viaduct, Joplin, Missouri, with an air brush. Sublimed Blue Lead in Oil works equally well for brushing, spraying or dipping. It will not harden in the con-

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One hundred pounds of Sublimed Blue Lead in Oil will rust-proof 5216 square feet of iron or steel. This is equivalent to a surface a foot wide and nearly a mile long. As well, painters find that Sublimed Blue Lead in Oil flows so evenly from the brush or air brush and spreads so smoothly upon the metal surface that they can cover greater area in a day and still produce a film free from breaks, runs or alligating.

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1

Castleton Cut-off Project Simplified

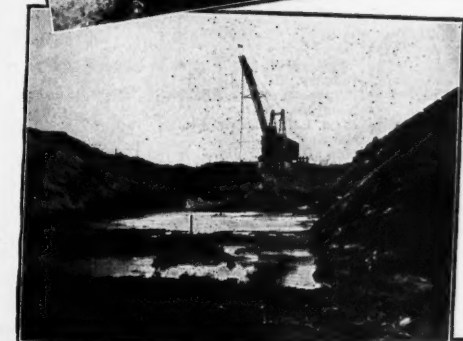
by application of efficient
methods and practical use
of du Pont Explosives

THE bigger and more difficult the contractor's job, the greater the need for reliable and efficient explosives.

In the construction of the Castleton Cut-off on the New York Central, skillful engineering overcame many of the problems, including the removal of thousands of cubic yards of rock and earth, but the excavation of 600,000 cubic yards of dense, indurated clay was the most difficult task encountered by the Walsh Construction Company. In co-operation with the du Pont Company these engineers employed du Pont Explosives in such an effective and practical manner that the excavation work was greatly simplified and expedited.

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Put your explosives problems up to the du Pont Company. There are 122 years of experience behind du Pont Explosives service.



3



4

1 West end of the new bridge spanning "America's Rhine," the Hudson River, at Castleton, N. Y.

2. Excavating Dorn's Cut, which is 71 feet deep, for two tracks.

3. The dragline operation known as Defreest Cut at the west end of the bridge. This cut is 6000 feet long and 25 feet deep.

4. A section of the Hoffmire Cut—looking west—and will accommodate two tracks.

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Explosives Department
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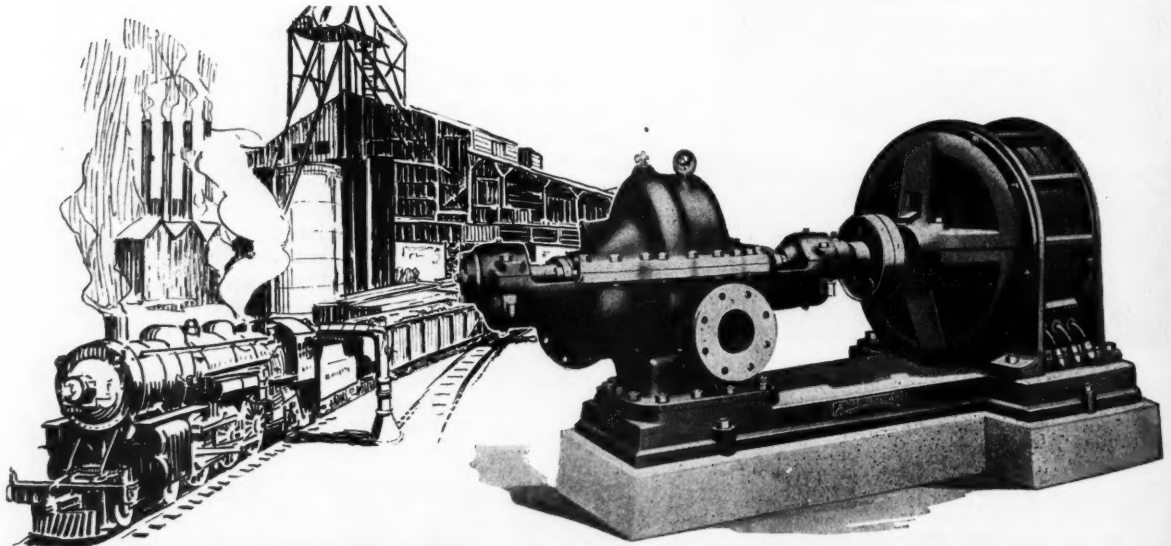
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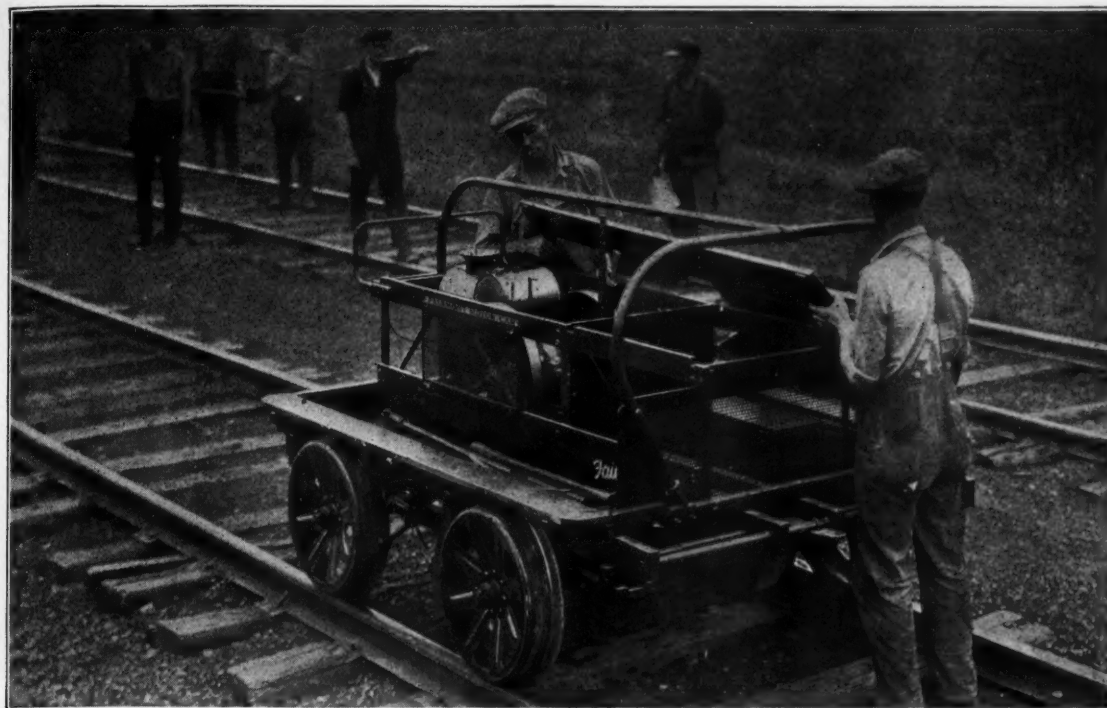
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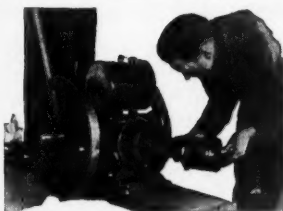
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Maintenance......55
Overhead......98
TOTAL.....\$2.71
Name of railroad furnished on request.



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Day after day, getting it done dependably and at lowest cost—this is the Fairmont way, as records prove beyond question and to everybody's satisfaction.

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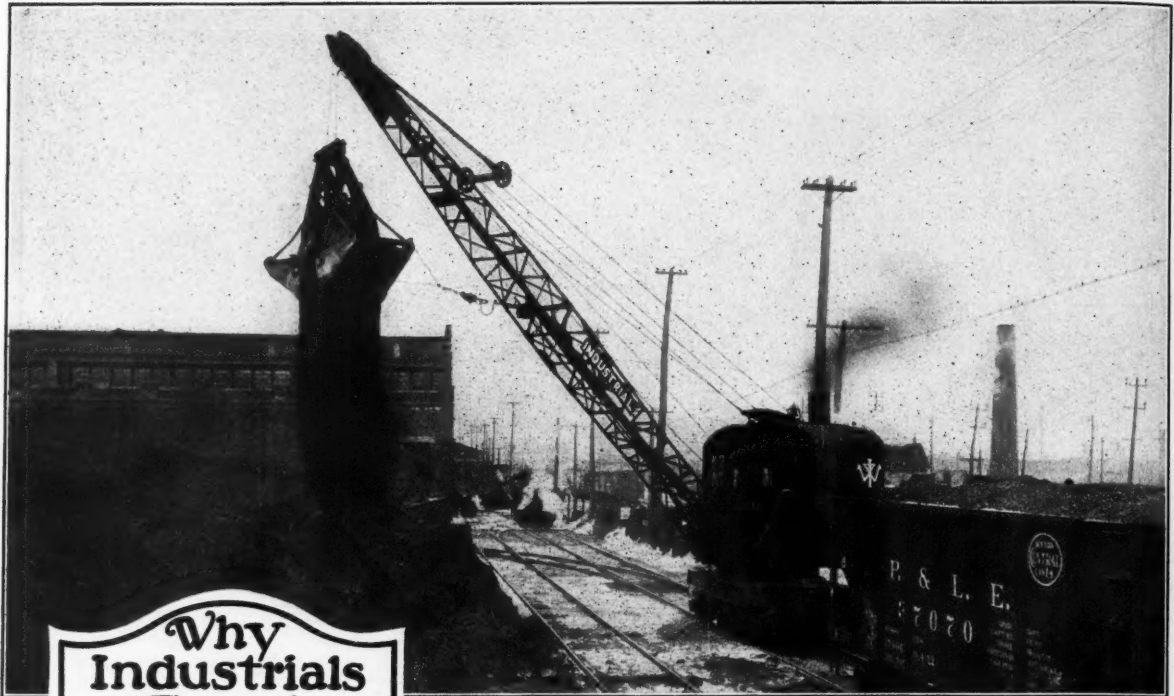
The result is that Fairmont builders have developed and brought to perfection most of the vital improvements in this important line of railway work.

Please read carefully the Panel descriptive of the Accessibility of parts in Fairmont. Then write us for still further information.

FAIRMONT RAILWAY MOTORS, INC., Fairmont, Minn.

Fairmont

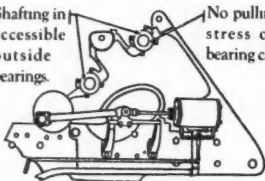
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Why Industrials Excel

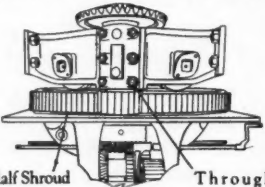
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Shafting in accessible outside bearings. No pulling stress on bearing cap.



Horizontal reversing engines make crane available for all services. Ropes unwind by power. Heavy loads are handled with security and accuracy.

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INDUSTRIAL LOCOMOTIVE CRANES

Railway Engineering and Maintenance

Volume 20

June, 1924

No. 6

CARE IN DETAILS

IT IS AXIOMATIC that every tie should be laid at right angles to the rails. It is equally important that every tie should be maintained in this position. It is known that ties tend to become slewed under traffic owing to the creeping of the rails. To arrest this movement rail anchors are installed. It is recognized that good maintenance requires the use of a sufficient number of anchors to stop this movement entirely and thereby prevent the disturbance and distortion of the track structure. However, not all slewing of ties results from traffic. The inception of slewing results too often from carelessness in laying the track. An examination of track which has just been laid will show that relatively little of it is reasonably free from criticism in this respect. In each step of the construction a tie originally laid askew is left so with the idea that it can be straightened with the next operation, with the result that it never is straightened and that it is frequently renewed by placing its successor at the same angle to avoid disturbing the bed.

At this season of the year when the construction of additional tracks is being undertaken, it will be well to insure that reasonable care be taken in the first placing of cross ties in order to minimize rail creeping and kindred track evils later. Insistence on such care will also tend to impress the necessity for carefulness in other details of track laying and, in fact, in other track work in general. The man who does his work neatly and accurately will usually be found to be an efficient man. Neatness may therefore well be fostered in this and other details of maintenance work on the track.

RIVER BANK PROTECTION

THE account of the serious difficulties which the Chicago & Alton encountered near Glasgow, Mo., as the result of the rapid cutting of the banks of the Missouri river, which appears on another page of this issue, calls emphatic attention to a phase of railway maintenance which has given a number of western railroads a great deal of trouble for many years. The railroads have literally sunk millions of dollars in these protection works for which they have nothing to show save the fact

they have been enabled to keep the river from invading the right-of-way and forcing them to seek more remote locations for their tracks. On those navigable streams on which the Rivers and Harbors division of the United States War Department has engaged actively in improvement work, the channels have been kept fairly well within control, but owing to lack of adequate congressional appropriations for this work many rivers have been under no control whatever, except such as has been imposed by the railroads in efforts to protect their tracks. Although it is a fact that the work which the railroads have done has also served in many cases to save thousands of acres of valuable farm lands, the railroads until recently have been compelled to fight the battle alone. In fact, a case has been cited on good authority where a farmer actually charged a railroad contractor for the right to occupy his land in the course of the bank protection work, notwithstanding the fact that the failure of the contractor to complete his work would have resulted in the loss of a large part of the farm. This situation has largely been corrected in more re-

HOLDING ONE'S JOB

An agent at a small town on the Missouri Pacific in Arkansas found recently that the total receipts of that station for six days amounted to \$14.20 and that it cost the railroad \$30 to keep that station open for that period. Impressed with the seriousness of this situation he addressed a letter to the shippers of that community of which the following is an abstract.

"Does the truck line enhance the value of your property? The railroad does. Does the truck line pay you a heavy school tax? The railroad does. Do truck lines build up communities and make them a more desirable place to live in? The railroad does. Do you realize that we need your patronage to make this a better railroad and that when we get it our revenues will increase and when our revenues increase our service to you will be improved? Give us your business."

The railroads are now experiencing a decline in traffic. This is causing them to postpone needed improvements and to reduce forces at a time when they should be increasing them. A considerable part of this reduction in traffic is attributable to the competition of the motor truck and the motor bus. If every railway employee will interest himself as this agent did in soliciting traffic from the shippers and travelers in his community, the present decline in business on his railway will be overcome entirely or in large part, the earnings will be maintained and his road will be enabled to continue its improvement work and retain rather than reduce its forces. The interests of the employee and his road are mutual. That road will be able to provide the greatest continuity of employment whose employees aid it in securing the maximum amount of traffic.

cent years by legislative enactments in a number of states, providing for the establishment of river bank protection districts financed by assessments against the properties benefited by such protection work in proportion to the benefit derived therefrom. As a consequence the railroads are now not required in all cases to pay the entire burden of the work in spite of the fact that others have benefited thereby.

HEAVY MAINTENANCE WORK ON DOUBLE TRACK LINES

THE MOST serious handicap to the efficient conduct of that maintenance of way work involving the use of the tracks, such as the relaying of rail and ballasting, is the necessity of permitting trains to pass from time to time. On single track lines this is unavoidable except insofar as freight trains may be scheduled to pass over the track in question outside of working hours. On lines of two or more main tracks, however, conditions are different for it is frequently possible to assign one track over to the maintenance force during working hours, concentrating traffic on the remaining track or tracks.

This can only be done, of course, with the co-operation of the division superintendent. While in effect, this causes material inconvenience in the handling of trains and for this reason is opposed by many superintendents, it contributes greatly to the progress of the maintenance work and hastens the elimination of all interference. It also reduces the cost of the work to a corresponding degree, while adding little if any to the annual out-of-pocket cost of train operation. For these reasons, it should receive the serious consideration of all maintenance of way and operating officers on multiple track lines, particularly at the present time when the traffic is lighter than a year ago and the demand for track capacity is lessened to that extent. Furthermore, in the face of decreasing earnings any savings which can be effected by the more efficient conduct of work are doubly important.

THE GRADE CROSSING PROBLEM

THE GATES at a crossing of an important highway over the tracks of a railway in the outskirts of Chicago are run through by autoists on an average of once a week. In Minneapolis four men are constantly employed in the repair of gates demolished by automobiles. These experiences, which are repeated daily in many other communities throughout the United States, are a constant reminder to railway men and to employees of the maintenance of way department in particular of the difficulties confronting the railways in protecting the public, or certain portions of it, against its own carelessness. The rapidly increasing seriousness of this problem is causing railway and public authorities alike to study it more intently and as they are delving more deeply into it they are coming to the common conclusion that the universal elimination of crossings is out of the question and that the problem is one of control rather than elimination of these points of danger.

In contrast with this conclusion and indicative of the attitude which still prevails in the minds of some is a statement made recently by an officer of a public regulatory commission of a middle western state to the effect that the enforcement of measures to control and protect highway traffic or require safe driving across railway tracks will create such a storm of prejudice as to overwhelm the railroads. Such a statement, if true, constitutes a serious indictment of the good judgment of the average American citizen, but we do not believe that

it is warranted by the experience in a few places where the control of traffic has actually been tried. In the cities where the requirement that automobiles shall stop before crossing boulevards are enforced, no such popular clamor has resulted. On the other hand, such measures are endorsed by the vast majority of the drivers because of the increased safety and speed of travel which they insure.

During the summer season which is now opening a greater number of vehicles will use the highways than ever before. Maintenance officers owe it to the public to insure that crossings are maintained in such a condition as to promote safe movement over them. They also owe it to those with whom they come in contact to call to their attention objectionable practices in the crossing of tracks and to impress upon them the necessity for the exercise of a reasonable amount of care on their part to protect themselves as well as those traveling with them.

HOLDING CULVERTS TOGETHER

THE DISCUSSION of corrugated pipe culverts which appears on another page places emphasis on the importance of adequate joints to insure against the spreading action of embankments pulling the sections of the culvert apart. This action of the embankment is not usually of sufficient intensity to result in serious trouble; in fact, it may be said that a relatively small proportion of all culverts experience trouble from separation of the sections, in spite of the fact that little provision is normally made for continuity other than that which is derived from the inertia or stability of the construction. Nevertheless, the tendency for culverts to separate at the joints is a matter that should be given serious consideration, for when it does occur it is attended with serious results. Some idea of the severity of the spreading action which may sometimes be imposed by the material in an embankment is to be had from the difficulty encountered recently in a large embankment which is now being constructed of material that is proving exceedingly unstable; in fact, so much so that the weight of the embankment is actually pushing the toe of the slope up a side hill and in so doing has carried the wingwalls and parapet of the culvert with it for a distance of several feet. Of course, such difficulties are not encountered frequently but they go to show that the builders of culverts must be on their guard to insure provision for such occurrences by anchoring or tying the sections of the culverts against this spreading action when there is any likelihood of its taking place.

MAKING BRIDGE WORK EASIER AND SAFER

THE READINESS with which men may climb over all parts of a large steel bridge or a viaduct for the purposes of inspection or painting depends largely on the amount of consideration which this feature of their maintenance receives in the design of the various details of the structure. Unless the matter of access to the various parts was taken into account in the design, it may be exceedingly difficult, if not decidedly hazardous, for a man to cover an entire bridge in the course of work which may be demanded of him. In the older bridges with smaller members this matter has not been particularly serious, but in the larger structures gusset plates in truss members or viaduct columns frequently assume such sizes that unless handholds are provided it is almost impossible for a man to climb by them.

As a measure of what can be done to facilitate the

work of the inspector or the painter, attention is directed to a large bridge now under construction in which the top faces of truss end posts are equipped with ladder rungs while the top chords are provided with hand rails. The girder spans, moreover, are equipped with permanent walks, both inside and outside of the girders, just above the level of the bottom flanges. As a consequence, the girder spans may be inspected without the use of any scaffolding, while painting will require scaffolding only for the work on the under side of the bottom flanges and the bottom laterals.

Steel bridges represent large investments and should receive conscientious attention, both in inspection and painting, but unless all parts of the structure can be reached with a reasonable degree of safety or convenience some portions are almost sure to be slighted. Failure to make adequate provision for access cannot be corrected readily after the structure is built but maintenance officers, by calling attention to these shortcomings in existing structures, may insure that they receive some consideration in the design of structures to be built in the future.

THE PREVENTION OF ENCROACHMENTS

THE SECTION foreman is the custodian of the right-of-way. Under the direction of the roadmaster and the division engineer he is responsible for the detection of encroachments on the property. From his intimate supervision and constant patrol over a short section of line, he is in a position to learn of every unwarranted intrusion on the property immediately after its occurrence. In the vicinity of station grounds this may consist of the erection of buildings wholly or in part on railway property, the construction of pipe lines across it or the storing of material on it, while between stations a common source of trouble is the relocation of fences. Such encroachments constitute a threat against the ownership of the property which, if uncontested for a sufficient period, may result in a loss of the property occupied. Instances of this are not rare. In fact, they are occurring almost daily because of the neglect of the railways to assert their ownership.

Another form of encroachment which is particularly serious because of the hazard involved is the wire crossings of telephone and power lines which are increasing rapidly throughout the rural communities. The local telephone lines ought to be watched particularly, because they are frequently of inferior construction and as a result are more liable to endanger the lives of trainmen and other employees on the tops of cars.

Foremen should be alert to observe and report encroachments of every kind and to see that they are prevented unless proper authority is shown. Supervisory officers can well afford to impress the importance of this subject on their men and instruct them in the steps which they should take. The first requirement is to provide the foremen with information concerning the limits of the property, either in the form of blueprints of right-of-way and station maps or by the establishment of the property line limits by permanent monuments.

EMPLOYEES SHOW INCREASE.—The number of employees reported by Class I railroads for February, 1924, the last month of record, was 1,753,289 or an increase of 3.362, or 0.2 per cent over the number reported for the previous month, according to the Interstate Commerce Commission. Compared with the same month of last year this is a decrease of 1.7 per cent in the number of employees.

New Books

Portland Cement Prices. By H. Parker Willis, professor of banking, Columbia University, New York, and John R. B. Byers, instructor in economics, College of the City of New York. 5½ in. by 7½ in. 124 pages. Bound in cloth. Published by the Ronald Press Company, New York.

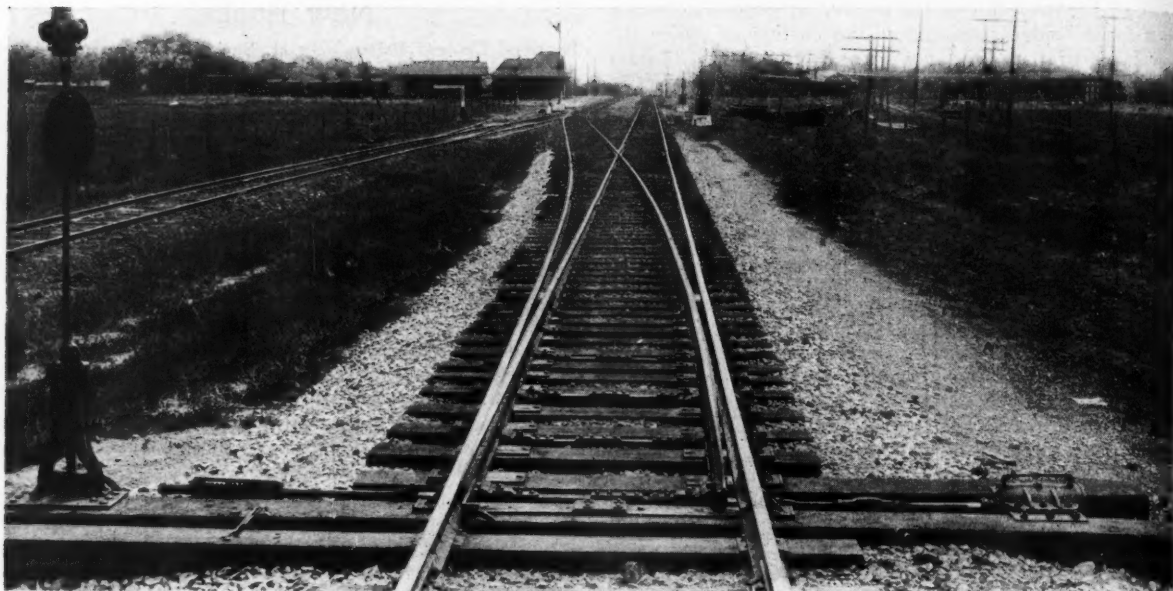
The book presents a detailed analysis of the current position of prices and price levels in the Portland cement industry. It presents the facts with regard to the economic conditions by which cement prices are determined, and although made at the request of some of the leading producers, represents the findings and opinions of the authors arrived at independently as a result of their investigations. These results form a valuable collection of data bearing on the cement industry, its methods of doing business, prices, profits and other contributing factors.

Appraisers' and Adjusters' Handbook. By William Arthur. 4½ in. by 7 in. 616 pages. Bound in leather. Published by the U. P. C. Book Company, Inc., New York.

This is a first edition of a new book by Mr. Arthur which is really a development, or more strictly speaking, an offshoot of his Building Estimators' Handbook in order to furnish data and information of value to those who are engaged in the making of valuations. In almost all valuation work, the original cost of buildings should be found if possible. This means that figures must be available for any year selected, within a reasonable period, so that they may be changed from the year of erection to suit the year of appraisal. In compiling the data for this handbook this plan was followed. The text is divided into two general parts. Part 1 deals largely with general principles, square and cubic foot costs, percentages of the various kinds of work, comparisons and approximate estimating. Part 2 shows how the detailed costs may be found.

Railway Permanent Way. A manual for engineers, inspectors and track foremen, by William Hepworth and J. Thomas Lee. 5 in. by 7 in. 400 pages, illustrated. Bound in fabrikoid. Published by Charles Sever, 40 King street, West, Manchester, England. Price \$3.

This is the first edition of a handbook dealing with problems of a dimensional nature encountered in the construction and maintenance of tracks, such as the planning and laying of curves and switch work. While of a mathematical nature throughout, the aim of the authors has been to provide an essentially practical work of immediate use to engineers in the field and at the same time within the comprehension of those intelligent persons interested in track problems who have not yet gained a working knowledge of the mathematical side of their work. The book is thus adapted as a text book as well as a book of reference, although, consistent with handbook practice, the reading matter is confined solely to the explanatory matter necessary to the working out of the problems considered. The book comprises chapters on Dimensions and Definitions; Rules for Drawing and Laying Out Curves, with problems; the Solution of Problems in Curved Track; Methods of Laying Out Switches, Crossings and Turnouts and separate chapters on various kinds of complicated switchwork. The book is thoroughly illustrated with sketches of the various problems, also with photographs showing various kinds of the more difficult turnouts. The publication shows painstaking work on the part of well informed students of present day practice and may be said to be a valued addition to the present day works of this character. While based primarily on British practice, the book should also prove useful in this country, in view of the high standards of British maintenance.



Spring Switch Installation at Burrton, Kan.

Use Spring Switches to Eliminate Interlockers on Santa Fe

Novel Method of Operating Yard and Siding Turnouts Proves Big Help in Cutting Train Costs

By D. K. CRAWFORD

General Signal Inspector, Atchison, Topeka & Santa Fe, Western Lines, La Junta, Colo.

BY THE USE of spring switches at the ends of passing tracks and at outlets of yards, the Atchison, Topeka & Santa Fe, Western Lines, have effected substantial savings in train operation and have eliminated the necessity of switchmen or small interlockers at several points. This type of spring switch, which was developed on the Santa Fe, is installed only where the speed in the direction of the facing point is restricted by rule or by grade, and only where automatic signal protection is available or readily provided. Four years' experience on this territory with this device has justified further installations.

Typical Layouts and Savings Produced

At Burrton, Kan., the switch at the west end of the double track, as shown in Fig. 2, is equipped with the spring device. Unless switchmen or an interlocking were provided, it would be necessary for a train to make two stops to operate this switch in passing out. A view of this switch is shown above. As the end of second track at this location is only temporary for a year or so, it was not advisable to install an interlocking plant. Trains pass from automatic to manual block territory at this point and are required to reduce speed for both facing point and trailing moves. By installing this switch and a signal, a switch tender was eliminated.

At Dodge City, Kan., the outbound freight lead from the yard, which is on a heavy grade, is connected to the eastbound main with a spring switch. This layout, as shown in Fig. 3, eliminates the stopping of tonnage

trains to operate the switch. Previously it was necessary to use a helper engine on outbound freight trains as they could not start on the grade after stopping to throw this switch, but since the installation of the spring switch the helper service has been dispensed with. At this location one back-up dwarf signal was required to protect train movements against the current of traffic in case of emergency and this signal increased the cost of the installation slightly.

Another of these spring switches was recently installed at the end of a passing track at Fox, N. M., as shown

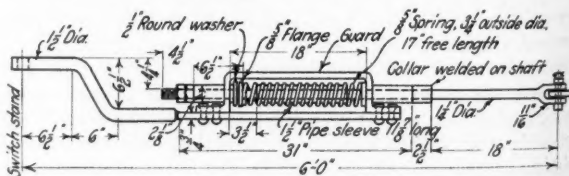


Fig. 1, The Switch Rod Equipped with the Spring

in Fig. 4. In this layout the cross-overs at the end of the second track near the station are operated and protected by an interlocking, but delays were caused to trains leaving the passing track on account of their being required to stop to close the switch. The installation of the spring switch has eliminated these delays and resulted in greater use of the passing track than heretofore. Also in case of emergency the end of second track can be extended to the end of the passing track.

The oldest installation of this design of spring switch on this territory has been in service at Hutchinson, Kan., for four years. In this layout, shown in Fig. 5, each end of a cross-over is equipped with a spring switch. The installation of these two spring switches has eliminated the services of switch tenders for three tricks, saving from \$450 to \$500 a month.

This type of spring switch consists of two essential parts, i. e., a special throw rod equipped with a strong spring against which the switch is closed, and an oil buffer to slow up the action of the spring on the return movement. A car wheel, in passing through the switch, forces the points open, and since each pair of wheels acts on the switch, the oil buffer is employed to eliminate unnecessary hammering.

The switch points and the switch circuit controller of the signal system receive two distinct movements for

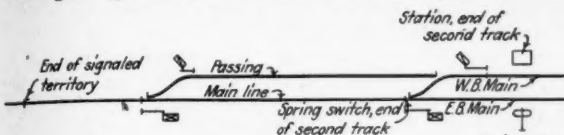


FIG. 2 LAYOUT AT BURTON, KAN.

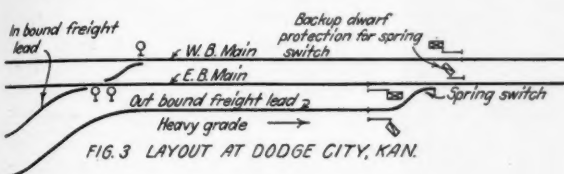


FIG. 3 LAYOUT AT DODGE CITY, KAN.

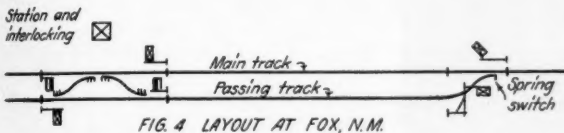


FIG. 4 LAYOUT AT FOX, N.M.

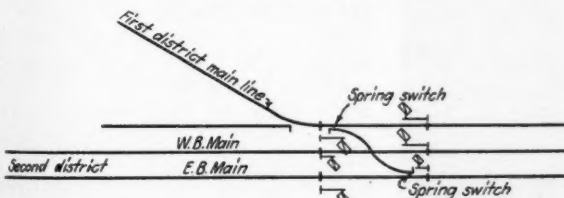


FIG. 5 LAYOUT AT HUTCHINSON, KAN.

Typical Installation of the Spring Switches

each car that trails through, which means 20 to 25 movements for each passenger train and from 50 to 150 for each freight train. Even under these conditions it has been found that the average life of the switch points, under heavy traffic, is between six months and a year. It was anticipated that the life of a switch circuit controller subjected to this service would be short but on two of these installations in yards which are subjected to severe use, both by through trains and switching, the switch circuit controllers are still in first class condition after four years' service.

EXCESS INCOME PAYMENTS—The Interstate Commission's recapture fund, representing the amounts paid by railroads as one-half of their net railway operating income in excess of 6 per cent preliminarily computed on their own statement of the value of their property, up to May 9 amounted to \$3,655,559, according to a statement furnished by the commission to the Senate and House committees on interstate commerce in connection with their hearings on Section 15a.

Clearing the Right-of-Way*

By F. N. GRIFFITH

Section Foreman, Kansas City Southern, Bunch, Okla.

THE FIRST and most important thing in mowing the right-of-way is to have good blades to work with. With a poor set of blades a man will do a poor job and will also progress slowly with his work. With a foreman and four men cutting right-of-way—and this is a pretty fair gang to work with—I start at the end of the section designated by the roadmaster with all of the men on the same side of the track, working so that we cut away from the rail. I cut for a distance of two or three telegraph poles on one side, then turn and cut back on the other side of the track. Five men can mow all of the right-of-way at one swath, with less running around. My section is mostly on a big fill, and two men can work on the fill and three men at the bottom of it. If you scatter the men, as is sometimes done with two men on a side, they have to run up and down the dump, tiring themselves out and losing time.

Brush hooks should be used on the high stubs. Many are found on the right-of-way which are three or four feet high. These should be cut, but the winter time is best for cutting them, for when the ground is frozen they are easily broken off, while if cut in the summer while the ground is soft and loose, the work will be slow and will leave bad holes in the dump. One man can cut as many stubs and stumps in the winter as an entire gang in the summer, for the dump is clear and he can see what he is doing. All limbs and old trees should be picked up and piled so that they can be burned easily when burning the right-of-way. A good grinder should be on the job all the time and blades should be sharpened at least twice a day, morning and noon.

As soon as the grass gets dry enough to burn, I clean around all bridges, telegraph poles, cattle guards and wing fences, also around tie stacks. Then as soon as the frost falls I get all the fire guards plowed that I can, and burn the right-of-way off just as soon as possible. In places where it is too rocky to plow fire guards, I burn as soon as the grass will ignite.

Whenever I burn right-of-way, I always take fire buckets and two or three sacks to fight the fire. I soak the sacks in water and if the wind isn't blowing hard I can handle most fires that start. Never burn right-of-way if the wind is high, because there is danger of a fire getting beyond control. I commence at one end of the section and burn it out of face.

*Abstracted from a paper presented before the Kansas City Southern Maintenance of Way Association at Neosho, Mo.

A Fable*

IN THE days succeeding the Centaur, when horses, mules and asses were used as the propelling power of vehicles to transport humans, gates were used to stop travelers on the highways when a railroad train approached. The horses, mules and asses, seeing the gate across the road, stopped, and let the train go by in safety to themselves.

In the progress of mankind motor vehicles were produced, and then the ass, instead of drawing the buggy, climbed into the front seat and became the driver of the flivver. Since that time he has usually been unable to see a gate at a railroad crossing, and if he did occasionally glimpse it, it was his delight to run it down in trying to beat the train across the track.

Moral—Keep the ass in his place.

*From the Daily Journal Press, St. Cloud, Minn.

Is the Corrugated Iron Culvert Adapted to Railroad Use?

A Study of This Problem Based on the Behavior of 10,000 Installations in Service up to 16 Years

By WALTER S. LACHER

FEW problems in the construction and maintenance of railway structures give rise to more lively arguments than that arising from conjectures as to the loads imposed on culverts in railway embankments. "Conjectures" is indeed the proper word to use in this connection, for it is only during the past few years that the first comprehensive efforts have been undertaken to ascertain by actual tests just what loads culverts must carry. Because of the lack of any reliable data on embankment pressures the designers of culverts have been compelled to rely on empirical rules based on experience with structures previously built. These practices have served very well for the design of wooden and stone box culverts and mass concrete arches, but as new forms of construction have been introduced it has been found impossible to apply the old precedents. Designers of concrete box culverts, for example, were confronted with this predicament and were compelled to establish some relation between depth of fill and assumed designing loads in proportioning the reinforced concrete covers. But on the whole their problem was one of extreme simplicity compared with that which faced those who advocated an entirely different form of construction, the corrugated sheet metal culvert. Some of these culverts were installed in highway embankment nearly 30 years ago, but it is only within the past 17 years that the various manufacturers of such culverts have made any concentrated efforts to apply corrugated pipe to railroad work.

No Precedent for These Culverts

As would be expected, these culverts did not at first meet with favor. They embodied a form of construction that ran contrary to all precedents. It is light, where all previous construction, even the wood box, was heavy and massive by comparison. It is constructed of material having a thickness of only a small fraction of an inch, whereas its nearest counterpart, the cast iron pipe, has a thickness many times as great. Railway engineers expressed doubt as to the ability of such light, flexible material to withstand the loads imposed by high embankments or by the more direct action of trainloads in shallow fills when all experience had pointed to the need of heavy, rigid construction. Moreover, the permanence of the material was seriously questioned. Introduced at a time when Bessemer and open hearth steel had enjoyed extensive

use over a sufficient period to demonstrate that sheet steel is a material of relatively short life, even when heavily galvanized, it seemed inconceivable that the sheet metal culvert could be expected to outlast even a wooden box.

However, corrugated iron pipes possess one characteristic which attracted the interest of railway officers and that is their light weight. This makes for economy and ease of transportation, but is particularly advantageous from the standpoint of installation. The cost of unloading them at the site of the culvert and installing them in place is much less than for any other form of construction. This work requires only a small force and very little equipment, usually makes work train service unnecessary and calls for little skill on the part of the men employed in placing them. These factors naturally exert a favorable influence on the cost of the corrugated metal culverts as compared with other forms of construction, and because of this economic advantage some of the railroads were willing to make trial installations in spite of some doubt as to their strength and durability. With the development of increased confidence in these culverts they have gradually received more extended use. Thus in 1923 more than six miles of corrugated metal culverts, in sizes ranging from 12 in. to 60 in., were purchased by the railroads from one group of manufacturers alone, for use under embankments carrying tracks.

As a consequence, there is now available a large fund of information on the service which these culverts have rendered in various parts of the United States for periods up to 16 years, which, in some measure at least, supplies answers to the questions which railway engineers have raised

concerning the strength of the pipes; the limitations to be imposed as to sizes of pipe and the minimum and maximum depths of fill, etc.; their behavior in unstable ground or under other conditions tending to disturb the continuity of the culvert; the precautions to be observed in installation; their hydraulic efficiency; and last but not least, the resistance which they offer to the action of the elements. The information presented relates largely to the results secured with one particular brand of culvert pipe but, in general, the conclusions are applicable to all classes of corrugated metal culverts, save that an exception must be made in the matter of durability. With respect to this, as will be explained later,



A 60-in. 10-Gage Culvert Under a 125-ft. Fill on the Western Pacific

each make of pipe must be considered on its merits based on service records of the particular material

Are the Corrugated Culverts Strong Enough?

As stated at the outset of this discussion, the important element in considering the qualities of a culvert construction is its ability to withstand the loads imposed by the embankment. In the course of the past 16 years corrugated metal culverts have been installed under embankments of varying height. In the majority of cases the height of fill has probably been moderate, but many of the pipes are buried under fills of 30 to 40 ft., a considerable number are under embankments of 50 to 80 ft. and at least one is in a 125-ft. fill. Careful inspections made of a large number of these culverts in various parts of the country show that they are giving excellent results. The photographs are illustrative of some of the installations inspected and, as will be seen, the captions record the size of the pipe, the depth of the fill and the name of the railroad.

It is true that some of the culverts have taken a somewhat elliptical shape, that is, there has been a moderate shortening of the vertical diameter and a lengthening of the horizontal diameter. In a number of instances this condition has been regarded by railway officers as an evidence of failure and, in a few cases at least, this has led to the replacement of the culvert. However, it would seem that in the great majority of cases this conclusion is incorrect, since this deformation represents the normal behavior of the corrugated iron culvert when subjected to heavy pressure.

It is not surprising, of course, that engineers who have observed this condition should feel some concern, since with the less flexible materials, such as concrete and cast iron, deflections to the degree observed in corrugated metal culverts would clearly indicate failure. However, concrete and cast iron pipe behave in an entirely different manner. They carry heavy loads with very little deflection, whereas corrugated metal culverts, being flexible, are very readily pressed into a somewhat elliptical shape without causing excessive stresses in the material. Therefore, the fact that a corrugated culvert has been found to have been deflected to an amount which would have resulted in the serious cracking of a concrete or cast iron culvert does not necessarily indicate failure of a more flexible construction.

In conclusion, therefore, it would seem that most corrugated metal culverts of good construction are giving good service in so far as it concerns ability to withstand the loads imposed. However, such information does not entirely satisfy the structural engineer. He looks for some explanation of the observed phenomena.

How the Culverts Function Under Load

Culvert builders have alluded for years to arch action in embankments as a factor tending to relieve the culvert of part of its load. In recent years the more analytical bridge engineers have been inclined to discredit this idea and contend that there is no reason under usual conditions why a culvert should not carry just as much of the weight of the fill as the natural ground surface on either side of the culvert. Tests made recently by Dean Anson Marston of Iowa State College go to show that, under some conditions at least, culverts may carry more of the load than that represented by the weight of the fill and the live load directly over it. However, in spite of these modern tendencies the idea of arch action persists.

Perhaps the best explanation to be offered for this theory is that suggested by the discussion of the recom-

mendations of the Committee on Masonry for designing loads for culverts at the last convention of the American Railway Engineering Association. It may be summarized as follows: Whether or not a culvert carries a load that is less or more than that represented by the weight of the prism of earth directly over it depends upon whether the culvert settles relatively to the ground surface and filling on either side of it or whether the ground surface and the filling on either side of the culvert settle more than the culvert does. In the first case the culvert will carry less than its share of the load, in the latter, more.

How Can the Culvert Be Relieved?

The obvious question raised by this proposition is, under what circumstances will the settlement of the culvert relative to the fill or the natural ground take place, whereby the culvert is afforded relief? One illustration of this is to be found in the concrete box or arch culvert built with a footing over only a part of its base area. Because the load is carried by a limited area this form of design results in greater foundation pressure under the footing than that imposed by the filling on the natural ground surface on either side and thus causes the culvert to settle more than the natural surface. Another interesting illustration occurs in the case of the corrugated culvert. These do not settle any more than the adjacent ground surface but instead the culvert itself takes the slightly elliptical shape previously referred to.

This characteristic deformation of the corrugated pipe as observed in culverts has two effects which bear an important relation to the ability of the culvert to function effectively under heavy embankment loads. First, the shortening of the vertical diameter serves to relieve the culvert of some of the superimposed load exactly in the same manner as if the culvert had settled bodily; second, the lengthening of the horizontal diameter compresses the filling material on either side, thus causing it to offer greater resistance to further deformation. It is believed that this affords a reasonable explanation for the fact that a corrugated pipe which offers little resistance to flattening when not supported at the sides has demonstrated its effectiveness as a culvert when buried in deep embankments or when used under track at a relatively small distance below the ties.

This resistance to crushing, which is offered by the pipe when adequately supported at the sides, has been demonstrated in laboratory tests in which the pipes were subjected to pressures applied by hydraulic jacks while the side support was provided by inserting the pipes in sand or earth in a box or trench. In a test it is assumed that the pipe has failed at the maximum reading of the pressure gage on the jack and when further depression of the jack deflects the culvert without increasing the pressure. Typical results obtained in such tests on 24-in. pipe are as follows: With No. 14 gage material the maximum pressure ranged from 9,500 to 10,000 lb. per lin. ft. of pipe with a deflection of 3.5 in.; with No. 12 gage material the maximum pressure was 15,000 lb. with a deflection of 4 in.; while with No. 10 gage material the maximum pressure was 23,300 lb. with a 3-in. deflection.

What Thicknesses of Metal Should Be Used in the Culverts?

It is generally conceded by engineers in the employ of the railroads as well as those associated with the manufacturers that much is still to be desired in the way of reliable information to serve as the basis for thoroughly analytical methods in the design of culverts, particularly culvert pipe. For this reason it has been necessary to

rely largely on the results of accumulated experience supported in some measure by laboratory tests. Obviously the design of corrugated pipes is no exception to this rule, but on the basis of extended experience the manufacturers have developed certain relations between gages and sizes of pipe which are recommended as representing conservative practice in their use under both railroad and highway embankments. As will be observed in the tables which are published herewith, they take no account of the depth of fill except to place a limit on the minimum depth of fill over the top of the culvert which is given as one-half the diameter but not less than 12 in., measured from the top of the culvert to the bottom of the tie.

Corrugated Culverts Under Tracks

| Nominal Diameter Inches | Area in Square Feet | Gage | Weight Per Foot |
|----------------------------|---------------------------|------|-----------------------|
| 12 | .785 | 14 | 13.2 |
| 15 | 1.227 | 14 | 16.0 |
| 18 | 1.767 | 14 | 19.3 |
| 24 | 3.142 | 12 | 34.9 |
| 30 | 4.909 | 12 | 43.6 |
| 36 | 7.069 | 12 | 52.0 |
| 42 | 9.621 | 12 | 60.6 |
| 48 | 12.566 | 10 | 88.1 |
| 54 | 15.904 | 10 | 98.6 |
| 60 | 19.635 | 10 | 109.1 |

What Is the Maximum Allowable Depth of Fill?

The record of corrugated culverts now in service affords precedent for their use under fills of almost any height. However, some railroads are restricting their installations to embankments of a limited height. For example, the Southern Pacific, which has applied a large number of these, has limited their use to fills of not more than 12 ft. on its Natron cut off now under construction in Oregon. Certain other railroads have not established such limitations.

In some cases this question has been answered by using heavier gages than the standard for higher embankments or other unusual conditions. For example, in a high embankment or on shifting and uncertain foundations, it has been found advisable to adopt No. 12 gage for 18-in. pipe, No. 10 gage for 24-in., 30-in., 36-in. and 42 in. pipe and No. 8 gage for 48-in. and larger sizes. Recently one manufacturer has perfected arrangements for the construction of culverts 48 in. in diameter and larger of No. 8 gage (11-64 in.) sheets. This, of course, will result in the development of a corrugated pipe adapted to much more difficult situations.

The above table shows culverts of 60-in. and 72-in. diameters but many railroads which are committed to the use of corrugated pipe do not employ the largest sizes. Some of them stop with 36-in. diameters, other with 48-in. But with the introduction of a No. 8 gage metal no doubt greater use will be made of the larger sizes. The 60-in. diameter has been used to a certain extent for installation inside timber culverts that were failing through decay, and where adequate precautions were taken to tamp sand or earth thoroughly into the space between the pipe and the old culvert these installations have been entirely successful.

Culvert Must Be Properly Installed

In considering standards of practice such as are outlined in the table it is important to bear in mind that proper precautions must be observed in their installation. The following is an outline of what is considered good practice in this regard and much of it applies with equal force to culvert pipe of all kinds. The culvert should be laid on an even bed, free from large stones,

and the fill should be thoroughly compacted about it up to the top. When the pipe has been buried to a depth of about two feet little further care is necessary in depositing sand, earth or gravel and the back filling may proceed rapidly by dumping from a trestle, if desired. Of course, if large stones or frozen clods form a part of the filling material these should not be dropped from a height until the pipe has been covered to a minimum depth of three feet and not less than its diameter.

The necessity for compacting the material on either side of the pipe also has an important bearing on the spacing of two or more pipes when placed in parallel groups. Many purchasers of corrugated culverts, both for highway and for railroad use, persist in installing twin or multiple pipes with their sides very close together, sometimes within one or two inches. This, of course, is not good practice. A good rule to follow in this regard is to place twin or multiple pipes with their sides not closer than one-half their diameters as it is only by observing this restriction that each culvert in the group may be properly bedded.

Good Joints Are Obtained

Another requisite for good results under certain conditions is that the several lengths of pipe as delivered at the site shall be properly coupled to insure a degree of continuity commensurate with the security of construction provided in the pipe as manufactured. Corrugated culverts of reliable manufacture are fabricated by effective lap riveted joints on the longitudinal and circumferential seams as in tank work. The rivets are placed in the valley with the head on the outside at a close spacing, with one row in pipes of the smaller diameters and two rows in the larger sizes. This means that the culvert as furnished comprises a substantial construction and unless the several sections are effectively joined the joints will comprise a weak element in the structure. However, the pipe may be furnished in any length desired, the only limits being those placed by practical considerations of transportation and handling in the field. As a consequence many culvert installations require no field joints at all.

Standard practice developed for the field joints of these culverts calls for what is known as the band coupler for use on the smaller sizes of pipe for conditions where the service is not unusually severe. This band coupler consists of a collar or section of pipe having a width of three or more corrugations, furnished with an open seam and rolled to a diameter slightly larger than the standard pipe. The opposing edges of the seam are fitted with two angle lugs punched to receive bolts by means of which the coupler is drawn up tight after it has been placed over the ends of the two sections of pipe to be joined. For the larger sizes of pipe and particularly where conditions indicate possibility of disturbing influences the pipe should be field riveted and the ends of the pipe section are furnished with rivet holes for this purpose. However, the band coupler, if properly made and applied, is usually a very effective joint and in cases where riveting is objectionable and a strong joint is deemed necessary, the band coupler may be strengthened by making it wider so as to cover more than the usual number of corrugations.

Advantage in Unstable Ground

The manner of coupling, referred to above, suggests a particular advantage of the corrugated culvert, namely, its security against pulling apart or other serious disturbance when placed in unstable ground. In general, it may be said that the culverts have functioned satis-

factorily in cases where severe settlement of the natural ground surface occurred with no other results than a sagging of the culvert at the center, while in cases where slides have occurred in embankments placed on side hills

where it was necessary to install the culvert on an extremely heavy grade the culverts have maintained their continuity, due, no doubt, to the effectiveness of the coupling. An unusually illuminating illustration of this



CORRUGATED CULVERTS IN SERVICE ON VARIOUS RAILROADS

Top row—A Culvert after 14 Years' Service Under an 18-ft. fill on the Soo in North Dakota. Installing a 12-in. Pipe in a Southern Pacific Yard near Los Angeles. A Double 36-in., 12-gage Culvert Installed Under a 17-ft. fill on the Great Northern in 1910. Middle row—A 48-in. Culvert Installed on the Chicago Great Western in 1911 by Tunneling and Jacking Through 30 to 35 ft. of fill. A 24-in., 16-gage pipe in Service in California since 1909 (Photo in 1919). A 48-in. Culvert in an Extremely Shallow fill on the Catawba Branch of the Norfolk & Western. Bottom row—Stone Masonry Head Walls Provided for a Double 36-in. Culvert Installed on the Boston & Maine in 1909. A Recent Installation of a 48-in., 14-gage pipe on the Pere Marquette.

property of the corrugated culvert was developed a number of years ago on the Northwestern Pacific between San Francisco, Cal., and Eureka, where the railroad experienced enormous difficulties with sliding formations and where unsatisfactory results had been previously experienced with other forms of culvert construction owing to the low efficiency of the joints.

Another aspect of the railroad culvert problem is suggested by one tendency observed in the use of the corrugated culvert, namely, the elimination of headwalls. In general, the use of headwalls of concrete or masonry is to be recommended and there are locations where there is a definite use for them as precautions against scour. Moreover, they give a finished appearance to the structure which could not be obtained without them, and



Placing a Corrugated Pipe Inside An Old Culvert

doubtless are employed for this reason in thousands of instances near stations and highways and in thickly settled regions. But the principal object of headwalls is to provide a cut-off wall to prevent the undermining of the culvert barrel at the inlet or outlet. As a means of obtaining greater security against scour in the absence of headwalls, some roads using corrugated pipe have provided for a greater extension of the culvert beyond the toe of the fill. However, in considering the advisability of omitting the headwalls, it is well to take into account their influence on head loss due to entrance and recent experiments indicate that the presence of a headwall, its design and shape, have some bearing on the hydraulic efficiency of the culvert.

What Is the Water Carrying Capacity of the Corrugated Pipe?

All known types of culverts with the exception of rough stone masonry and corrugated pipe have relatively smooth surfaces. Therefore, the question of the coefficient of friction as affecting the discharge of water through the culvert never received much consideration until the active introduction of corrugated culverts. Owing to the fact that these metal culverts present an undulated surface to the water it is natural that engineers should be curious as to the effect of these corru-

gations on the friction factor to be assumed in any calculations of discharge. Fortunately, some definite information has recently become available on this phase of the culvert problem.

Through a co-operative arrangement with the U. S. Bureau of Public Roads and the University of Iowa, a series of hydraulic experiments was carried out on concrete, vitrified clay and corrugated culvert pipe at the laboratory of the university, the results of which have been published in the Journal of Highway Research of the U. S. Department of Agriculture for March, 1924. Briefly, the results of these tests show that the discharge through a corrugated culvert pipe up to and including the 48-in. diameter is somewhat less than that through a concrete or a vitrified clay pipe. These tests were all made with the pipe flowing full with heads ranging from 0.01 ft. to 3.5 feet. Thus an 18-in. corrugated pipe, 30.5 ft. long, discharged from 23.3 to 29.3 per cent less water than a concrete pipe of the same size and length. The 24-in. pipe carried from 17.6 to 26.2 per cent less, the 36-in. pipe from 10.3 to 22.5 per cent less and the 48-in. pipe from 4.5 to 19.5 per cent less.

This difference in hydraulic efficiency may also be expressed in terms of the diameters of pipe of the same carrying capacity. For example, the water discharged by a 24-in. corrugated pipe from 30 to 60 ft. long will be carried by a concrete pipe from 20 to 22 in. in diameter, depending on the length of the culvert and the character of end details. Similarly the discharge of a 42 in. corrugated pipe may be obtained with concrete pipes from 36 to 40 in. in diameter, while the discharge from a 48-in. corrugated pipe may be obtained with concrete pipes from 42 to 47 in. in diameter. Of course, in presenting these figures for odd sizes of pipe it is realized that culvert pipes must be purchased in standard sizes. They are given, however, by way of illustration of the relative hydraulic efficiency of the two kinds of pipe. This, of course, is only one factor to be taken into consideration in selecting the type of culvert to be used and may be of minor importance in some cases.

Are the Culverts Durable?

Among the most vital questions which arise with respect to the corrugated metal culvert is that of its resistance to corrosion. This is highly important because it is poor economy to install a culvert under anything as permanent as a railroad embankment which will not insure a long life. The cost of a new culvert may be relatively small but the expense of replacing a structure buried in a fill is usually so great as to justify a sufficient outlay in the initial installation to insure a long life.

The answer to the question of permanence is complicated by the fact that a number of different varieties of iron and steel are being used in the manufacture of corrugated pipe and it is not to be expected that the same service will be rendered by each class of material. Therefore, in considering the resistance which a culvert is giving to the action of the elements it is necessary to know just what material was used in its construction. It is well known that some culverts have given poor results and owing to a failure to discriminate between materials there has been a tendency to condemn all classes of corrugated culverts because of unfortunate experience with a particular type or brand.

To avoid confusion, therefore, the following discussion has been restricted to the results obtained with culverts made of one material, the ingot iron manufactured by the American Rolling Mill Company of Middletown, Ohio, which is fabricated into culverts by the

member companies of the Armco Culvert and Flume Manufacturers' Association, this particular make of culvert having been selected because its extensive use affords the maximum volume of service records. While corrugated culverts made of certain other materials may, no doubt, afford somewhat comparable results, accurate conclusions concerning their merits must be based on independent investigations.

The Armco culverts have been in use for upward of 17 years, which is, of course, too short a time to develop the full life of a material possessing the degree of durability to justify its use under a railroad embankment, but the condition of a structure at the end of 17 years should furnish a reasonable measure of the



Condition of 24-in. Pipe Removed from a Railroad Embankment After 10 Years' Service Because of Faulty Installation

service to be expected of it and reports on inspections of some 10,000 of these culverts under widely different conditions in 24 states shows that nearly all of them are now in good condition, as illustrated in the photographs. Many of them are said to retain the galvanizing practically intact, while many others which have lost a part of the galvanizing and are somewhat rusty where this has occurred are sound and strong, and are undoubtedly good for a long period of further service. The fact that some of the culverts have lost a portion of their galvanizing is not to be taken as an indication that they are approaching the end of their service life, since experience shows that pure iron sheets rust slowly and evenly and that culverts under such circumstances seem to remain in practically the same condition for many years.

Similar Material in Use 30 Years

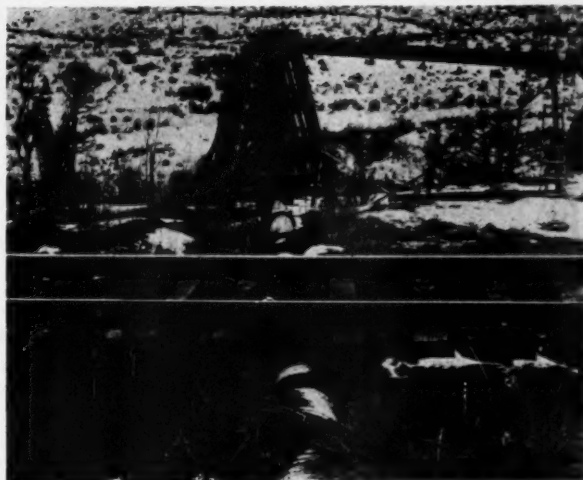
Although service records for ingot iron culverts extend over only 17 years it is possible to cite service records covering nearly twice that period for material of a somewhat comparable nature and which may be considered, in a sense, the forerunner of the high purity iron of today. About 30 years ago some corrugated black iron culverts were installed in highways near Crawfordsville, Ind. The metal in these culverts represents an interesting illustration of efforts made to overcome the deficiency of steel sheets in resisting corrosion. It was made by placing bars of charcoal iron at the top and bottom of box piles of steel bars, the whole being heated and rolled into sheets. The result was to produce a steel sheet with a very thin layer of relatively pure iron on both sides. These culverts were

not galvanized and most of them show no indication of ever having been painted. Some of these piled iron culverts are still in excellent condition and one of them, recently exhibited at the National Railway Appliances exhibit, had apparently lost but very little of its original thickness. Those of these old culverts which are now failing have lost the outside coating of pure material.

Experience Under Severe Conditions

Under especially severe conditions such as exposure to alkali, acid, salt-water, sewage, etc., Armco culverts have been known to rust seriously and there have been some cases of entire failure. For example, a number of No. 16 gage culverts under a western railroad were inspected during the past summer at a place where the ground and water are heavily impregnated with chloride alkalies. A test of a water sample taken at this point showed three times as great a concentration of salts as is found in sea-water and the surface of the ground is encrusted with whitish substances to a depth of an inch or more. High purity iron will resist even these conditions much better than ordinary steel, but these culverts are seriously rusted and now after 15 years of service are about ready for replacement. They will be renewed shortly with culverts of No. 10 gage material.

Somewhat similar conditions are encountered where culverts are placed in salt or brackish water, especially



A 14-in. Corrugated Iron Pipe Used As An Irrigation Syphon in Cinder Ballast

in warm climates. Acidulated water from coal mines is very damaging to any iron or steel. Engine cinders exert a bad influence if placed in contact with corrugated pipe and some have been severely damaged from this cause, although in other places, for instance, the installation shown in the photograph above, the pipe seems to be but little affected. There is reason to believe that a little care in installation, as, for example, by protecting the culvert with a blanket of sand, clay or gravel, will greatly reduce the danger of deterioration from this cause.

This material is not recommended for long time service under any of these severe conditions. However, there are instances where the mechanical advantages of this form of pipe may recommend it as the best thing to be used in spite of the prospect of shorted life under the circumstances. For such installations, it is suggested that better results will be had with the heavier gagees of pipe protected by a coating of some bitumen compound. How-

ever, in calling attention to these limitations to the use of the corrugated iron culverts it is not out of place to recall that it is under these same circumstances that unsatisfactory results have been experienced with other materials used in culvert construction, so that a study of the conditions at a particular location may show that the iron culvert may afford the best solution of the problem in spite of the limitations mentioned.

The following conclusions are offered as a summary of the foregoing discussion. Corrugated metal culverts have been used in sufficient number for an adequate period to provide a substantial basis for a study of the service they render. Culverts of good construction are sustaining the loads imposed by railroad embankments with but few failures. Their ability to withstand heavy loads has been verified by laboratory tests. Their limitations as to maximum depths of fill have not been definitely ascertained although many are giving excellent service under high embankments. They possess a definite advantage in unstable ground, but have somewhat less hydraulic efficiency than other types of culverts. Certain brands of corrugated pipe have demonstrated a resistance to the action of the elements which insures long life for all ordinary conditions. In conclusion, the ease with which the corrugated pipe may be installed points to their definite economic advantages for culvert installations, and railway officers may well make such personal investigations as will enable them to arrive at independent conclusions with respect to the utilization of this construction on the lines under their charge.

Highway Grade Crossings Present Grave Problem

IN THE SIX years from 1917 to 1922, inclusive, an average of 1,818 deaths and 4,898 injuries per year occurred at railroad crossings of highways while during 1923, 2,268 persons were killed and 6,314 injured, making a total of 8,582 casualties for the one year. Consideration of this enormous loss of life and the discussion of measures which may be taken to prevent it in the future was the subject of a conference on the grade crossing accident problem, held at Chicago on April 30 and May 1 at the instance of the National Association of Railroad and Utility Commissioners.

Naturally the discussion at this meeting centered largely on the elimination of the crossings of railroads and highways and this brought out the fact that there are 256,362 grade level crossings on the Class I railroads in the United States. Careful estimates of construction requirements showed that the average cost for the elimination of a highway grade crossing is \$75,000, so that it would cost nearly \$19,000,000,000 to eliminate all of the grade crossings. While the vastness of this sum is, in itself, a definite demonstration of the impossibility of any such project its futility is demonstrated even further by the fact that although 705 grade crossings were eliminated during the calendar year of 1922, 4,562 new grade crossings were added, making a net increase in the number of grade crossings for that year of 3,857.

While devoting considerable time to the discussion of grade crossing elimination, a large part of the deliberations at this meeting concerned measures for the increase of safety at grade crossings. Emphasis was placed on the fact that a large proportion of the accidents resulting from the irresponsibility or inexperience of the driver and his failure to exercise proper caution in approaching and crossing the tracks. The extremely

low prices at which used cars may be purchased has resulted in placing them in the hands of many persons mentally unfit to drive a car. This condition, it was pointed out, made it highly important that the drivers of automobiles be required to secure licenses based on examinations for physical, mental and temperamental qualifications and that these licenses should be made revocable for cause, as, for example, demonstrated recklessness, violation of regulations, intoxication, etc.

The responsibility of the railroads with respect to grade crossings was also dwelt upon. The necessity for making the crossing as safe as possible by providing the maximum range of vision through the removal of obstructions to the view was among the measures proposed. The relocation of crossings to make them as nearly square with the tracks as possible was offered as a further improvement. Discussions of the character of warning devices, gates, the maintenance of crossing watchmen, etc., indicated rather wide differences of opinion and shows that any high degree of uniformity with respect to such safeguards is not to be expected for some time.

The conclusion reached by the conference was that the separation of grades of all highway railway crossings is physically and financially impossible of attainment within the lifetime of men now living and that relief must be sought through a variety of measures which were summarized in resolutions as follows:

(1) The elimination of grade crossings should proceed in an orderly and expeditious manner. The creation of new crossings should be avoided wherever possible.

(2) Highways which cross and re-cross tracks should be relocated.

(3) Adjacent crossings should be consolidated.

(4) Physical conditions at crossings should be favorable to the highway traveler.

(5) The proximity of railroad tracks should be designated by standardized, uniform and unmistakable indications.

(6) All extraneous signs and devices should be excluded from the immediate vicinity of grade crossings.

(7) Railroads should give ample notice of the approach of all trains.

(8) The right to drive a motor vehicle on a public highway should be restricted to qualified possessors of a license issued by proper authority and revocable for cause.

(9) Motor vehicle accidents involving personal injuries should be reported to public authorities for statistical and other purposes.

(10) Motor-driven carriers for hire upon highways should be under the jurisdiction of railroad and utilities commissions.

(11) Such commissions should be empowered to require all such carriers for hire to stop and take full precautions at railroad crossings.

(12) In states where a full stop is not required by law motor drivers should be forbidden to exceed a speed of 10 miles an hour within 300 ft. of any railroad crossing until positively assured that no train is approaching.

(13) Red should be used only to indicate imminent danger and positive stop. Cautionary indications, including the rear lights of automobiles should be of some other color.

(14) Crossing flagmen should be invested with authority to arrest persons disregarding stop signals.

(15) Public interest in the prevention of highway-railroad crossing accidents should be cultivated by every available means.

(16) The principles of safety should be included in the curriculum of every school.

(17) Further conferences should be called by the National Association of Railroad and Utilities Commissioners as occasion warrants.

(18) The problem of highway crossing accident prevention demands a continuance of the sincere and cordial co-operation established at this conference. (The chairman was authorized to designate some one to whom communications may be addressed, and interested organizations were requested to designate representatives to assist in co-ordinating effort.)

(19) A general realization of individual, personal responsibility will bring about immediate mitigation of crossing hazards.

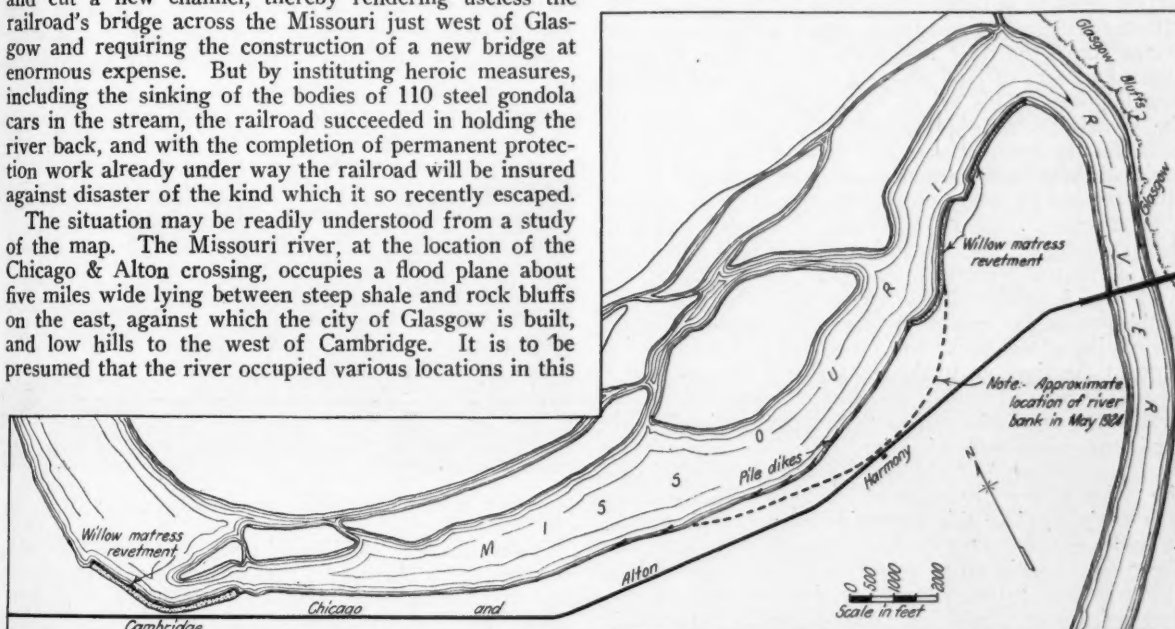
Chicago & Alton Defeats Missouri River by Narrow Margin

Use of Unusual Methods Holds Banks of Stream Which Threatened to Cut Railroad in Two

AFTER A 50-year fight to protect five miles of its main line in the vicinity of Glasgow, Mo., against almost continuous attacks of the Missouri river, the Chicago & Alton missed a disastrous defeat by a very narrow margin early in May. The cutting of the river bank brought the river so close to the track at one point as to carry away a part of the toe of the embankment and for a time there were grave fears that the river would succeed in breaking across the right-of-way and cut a new channel, thereby rendering useless the railroad's bridge across the Missouri just west of Glasgow and requiring the construction of a new bridge at enormous expense. But by instituting heroic measures, including the sinking of the bodies of 110 steel gondola cars in the stream, the railroad succeeded in holding the river back, and with the completion of permanent protection work already under way the railroad will be insured against disaster of the kind which it so recently escaped.

The situation may be readily understood from a study of the map. The Missouri river, at the location of the Chicago & Alton crossing, occupies a flood plane about five miles wide lying between steep shale and rock bluffs on the east, against which the city of Glasgow is built, and low hills to the west of Cambridge. It is to be presumed that the river occupied various locations in this

interruptions of traffic. These flood experiences, however, must not be confused with the difficulty which the railroad encountered because of the erosion of the river bank since this action frequently occurs with greater severity during times of low water than at flood stages. Moreover, danger from floods has been substantially eliminated by raising the grade of the track across the bottoms to a level that places it well above anticipated high water. But the menace of the continuous erosion of the river



Map of the Chicago & Alton's Crossing of the Missouri River

valley during times past, but within the limits of recorded history it has followed a channel from the north along the west side of the valley with a short turn to the east at Cambridge bend, thence continuing easterly to Harmony, where it turns northwest until it impinges against the bluffs at Glasgow, which deflect it to the south along the face of the bluffs.

Railroad Parallels River for Five Miles

The Chicago-Kansas City line of the Chicago & Alton crosses the river just south of the town of Glasgow on a high level bridge which terminates in a high embankment on which the grade descends to the general level of the bottom lands that are traversed on a location parallel with and from 100 yd. to $\frac{1}{4}$ mile south of the river to the foot of the ascent up the west side of the valley west of Cambridge.

The territory occupied by the railroad throughout the entire five-mile crossing of the river valley is typical river bottom land—sand and alluvial soil, considerable of which is subject to overflow at times of extreme high water which have resulted several times in washing out portions of the railroad embankment, causing temporary

banks, which was realized shortly after the railroad was built, has been a source of concern to the management almost continuously since that time. In 1880 and 1881 the United States government constructed sections of mattress revetment at Cambridge and Harmony but since that time the burden of guarding against the erosion of the river has been imposed entirely on the railroad, which has spent several hundred thousand dollars in additional protection work, in the form of long stretches of mattress revetment and a series of pile dikes.

Difficult Problems Involved

The prosecution of the protective work has been attended with considerable difficulty owing to the periodic formation of new subordinate channels between the islands to the north of the main channel. This has resulted in repeated changes in the position and direction of the current whereby the severest cutting action is encountered at new and unexpected points along the south bank, frequently carrying away many acres of land before suitable measures could be interposed to stop it.

Renewed action of this kind occurred in the vicinity of Harmony during the past year and led to plans for pro-



Brush Weighted with Rock Did Not Stop the Cutting

tection work to be carried on jointly by the railroad, the Missouri Highway Commission, which is building a new bridge across the river just south of the Alton crossing and the owners of land adjacent to the railroad and the new highway. This led to the award of a contract to the Woods Brothers Construction Company of Lincoln, Neb., for the construction of 19 current retards, consisting essentially of large masses of trees, anchored in the river channel by means of Bignell concrete piles sunk to a great depth in the river bottom. However, owing to delays incident to the conclusion of a definite agreement with all parties concerned, the active prosecution of this work was delayed until this spring, and before the work could proceed far enough to become thoroughly effective the cutting of the banks had proceeded to a point which brought the river up to the right-of-way line on May 1 and the situation became exceedingly critical.

Efforts were made at once to stop the cutting by protecting the river bank with brush and trees held in place by cables anchored on the shore but, while this retarded the action of the current near the surface, it was found impossible to place this protection deep enough to prevent the scouring at greater depth with the result that the current continued to undermine the banks, which, in turn, continued to cave at an alarming rate and within a few days the river bank had reached the railroad embankment and at one point caused the sloughing off of the embankment slope almost to the ends of the ties of the passing track at Harmony. It was evident that the situation called for heroic methods. Accordingly, W. G. Bierd, receiver of the Chicago & Alton, who had assumed direct charge of the work on May 1, ordered a



Wrecking Cranes Rolled the Car Bodies Off the Track

large number of old steel gondola cars to be sent to Harmony where, with the aid of two wrecking cranes, they were rolled off the track into the river. The car bodies did not immediately sink into deep water so as to become completely submerged. This resulted in the formation of a pool of slack water between the cars and the bank into which large masses of brush could be deposited and sunk with rock. Then, as the cutting of the channel continued in the deeper water, the cars and weighted brush slid into the deep water and produced an effective barrier against the further erosion of the bank.

Snag Boat Aids in the Work

While the plan for the use of the car bodies for this purpose was being formulated it was realized that they could not be readily rolled into the river by the use of the wrecking cranes alone at points where the river bank was still at a considerable distance from the track. A way out of this difficulty was suggested by the passing of the government snag boat, Missouri, just at the time that these plans were under way and as this is a large boat with powerful hoisting equipment, it was suggested



The Snag Boat Pulled the Cars Into the River

that the steamer would be of great assistance in launching the cars. Thereupon, Mr. Bierd wired to the Rivers and Harbors officers of the War Department with the result that Major General Lansing H. Beach authorized the use of the snag boat for this purpose and it proved most effective. After the wrecking cranes rolled the car bodies down the embankment, a line from the hoists on the snag boat was passed over the top of the car body and down underneath and around it and then, as the line was hauled in, the body was rolled over and over until it fell off the edge of the bank.

The rolling of these cars into the river was followed by the placing of large masses of brush and rock between the cars and the banks.

By May 21 the work had proceeded to a point which indicated that the immediate danger of further erosion of the river bank had been overcome. During the time that this emergency work was in progress every effort was made to interfere as little as possible with the work of the contractor in the construction of the permanent retards. This work is now progressing at a satisfactory rate and with the completion of the 20 retards, one additional one having been authorized since the contract was awarded, the officers of the railroad and the highway commission feel reasonably certain that further danger to the railroad and highway has been effectively prevented.

We are indebted for the above information to R. A. Cook, chief engineer of the Chicago & Alton, Chicago.

New Pumping and Softening Plant Is Electrical Throughout

Installation at Clinton, Ill., Illustrates Possibilities of Automatic Control in Railway Water Service

By C. R. KNOWLES

Superintendent Water Service, Illinois Central

A NEW WATER supply facility has been built at Clinton, Ill., on the Illinois Central, which is considered noteworthy for its completeness and particularly for the electrical features involved. The facilities consist of three deep wells equipped with turbine pumps and a 50,000 gal. per hour water softener, all of which are electrically driven, together with filters, pipe lines and an additional storage tank having a capacity of 100,000 gal.

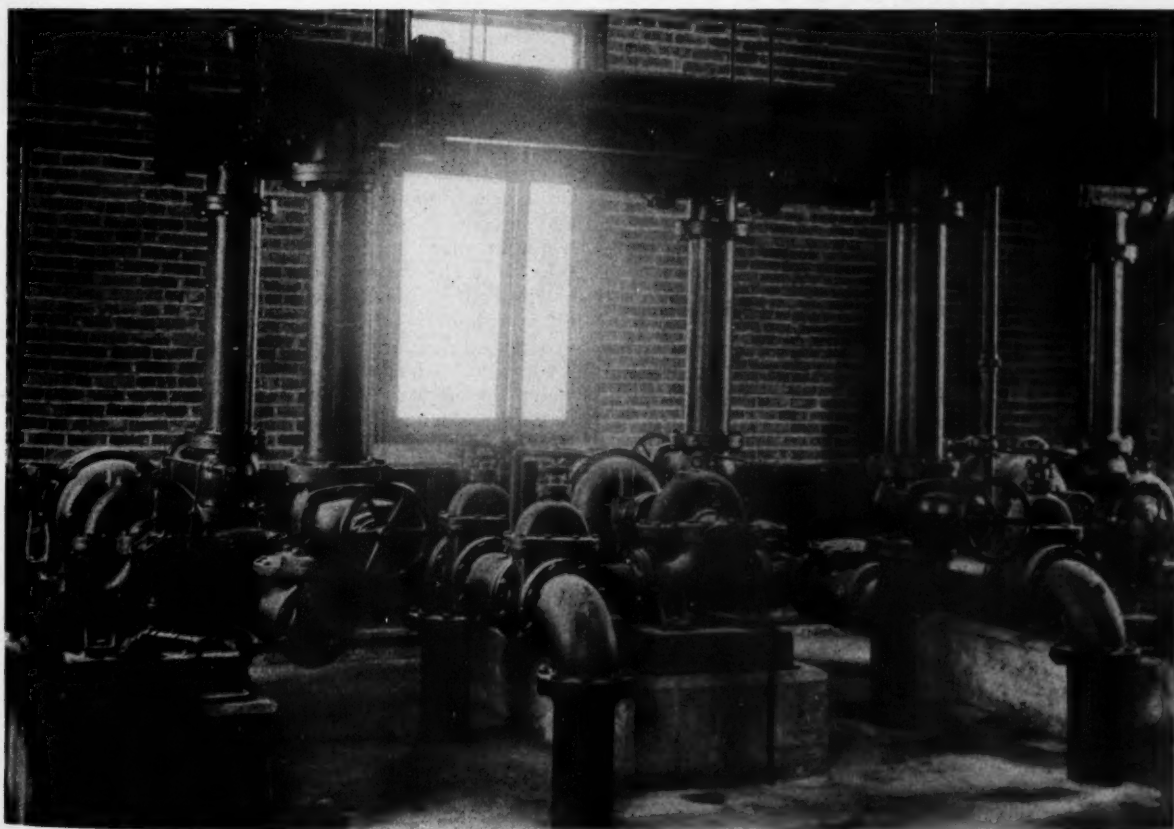
Clinton is located midway between Chicago and St. Louis, the hub of six engine districts. It is also the headquarters of the Springfield division and the site of one of the principal mechanical terminals and locomotive shops on the system. An average of 70 engines are handled through the roundhouse daily in addition to making general repairs to about 180 annually. The daily consumption of water for all purposes is approximately 1,000,000 gal.

The water supply was originally obtained from a reservoir having a capacity of 12,000,000 gal., located in the vicinity of the shops and supplied by surface runoff. This supply was ample for many years but as the con-

sumption of water increased with the greater volume of business handled the supply from the reservoir became inadequate during the late summer months and in 1900 a pumping station was constructed on a stream about four miles southeast of Clinton and the water pumped to the reservoir through an 8-in. pipe line 20,000 ft. long. These facilities proved adequate until the past few years when the consumption of water continued to increase to such an extent that the shops were threatened with a shortage during the late summer months each year. An abundance of ground water is available at a depth of 340 to 350 ft., and while this water is not of the best quality it offered the only available means of providing an adequate year-round supply.

New Supply from Three 18-in. Wells

Three wells were constructed, each 18-in. in diameter, to a depth of 200 ft. and 10-in. in diameter from 200 ft. to 350 ft. deep. The water-bearing sand stratum is 90 ft. in depth while the length of strainer is 55 ft. The 10-in. casing extends from the top of the screen to a point 20 ft. above the bottom of the 18-in. casing; the



The Pump House Interior Where Pipe Friction Is Reduced By Using Long Elbows

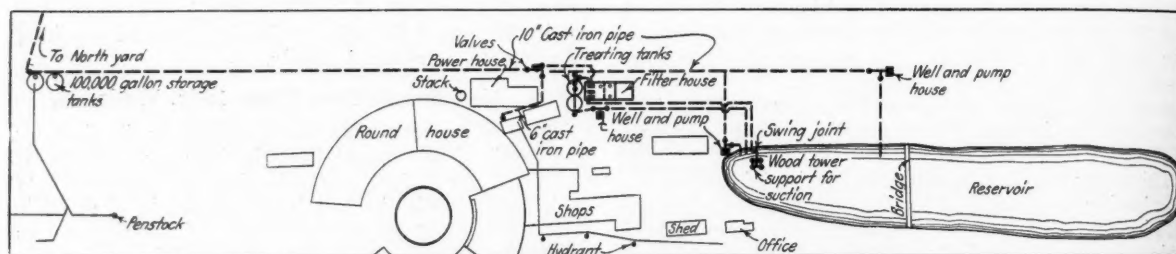
seal between the 18 in. and the 10 in. casing being formed with gravel to exclude the sand.

The pumping equipment in the well consists of 5-stage turbine pumps having a 7-in. suction and 9-in. discharge. Each pump is driven by a vertical 85 hp. 440 volt, 3 phase synchronous motor. The pumps tested out 763 gal. per min. with an electric input of 65 to 70 amp. or about seven-ninths of the rated capacity.

The piping arrangement of the wells is such that they can be pumped either into the reservoir or the softening plant or direct to the storage tank. Each well is equipped with an automatic control panel located in the pump house, these panels having the usual electrical equipment such as starters, overload and no-voltage protection as well as automatic and push button control, the push button control being so arranged that the pumps can be started and stopped from the water softening plant, if desired, thus placing the well pumps at all times directly under the control of the treating plant operator. Under normal operating conditions when pumping to the treating tanks the operation of the well pumps is automatic, the control being through float switches in

zonally in each tank, affording a means of mixing the dry chemicals with water in the batch tank and maintaining a uniform solution in the feeding tank. These paddles are driven by an electric motor through bevel gears, and are so arranged that the agitation in the batch tank can be discontinued without interfering with the operation of the agitators in the feeding tank. The upper tank is arranged with a valve so that a batch of chemicals can be admitted to the feeding tank at any time. This arrangement of a separate batch and feeding tank permits the preparing of a charge of chemicals in advance of the time when it is required and avoids interruption to the feeding of chemicals and other troubles that often occur when the chemical charge is mixed directly in the solution tank.

The chemical solution is pumped to the top of the treating plant by a 3-in. by 3½-in. triplex pump, which discharges a constant stream of chemicals into the proportioning device. This proportioner consists of a tank of special design where a constant level of the chemical solution is maintained by means of an overflow pipe at one end, through which the excess chemicals flow back



A Partial Diagram of the Clinton Yard Showing the Layout of the New Work

the roadside tank and in the treating plant clear water wells.

The pump houses over the wells are of brick construction 12 ft. by 14 ft. in size with concrete floor and roof and metal sash and doors. Each house is equipped with a permanent derrick for raising and lowering the droplines and pumps in the well and all discharge lines from the wells are constructed of 10-in. cast iron pipe with long-radius bends and branches to insure the minimum friction loss.

The Water Softeners Are Connected in Series

The water softening plant is a twin tank continuous system of the lime and soda ash type with two conical bottom steel tanks having a capacity of 100,000 gal. each. These tanks are operated in series, one of the tanks being equipped with an 8-ft. downcomer or reaction chamber extending from a point 5-ft. above the tank to within 12-in. of the bottom.

The chemical solution mixing equipment consists essentially of two steel tanks, one set above the other, the upper tank being the batch or mixing tank in which the dry chemicals are introduced in a predetermined quantity, while the lower tank is a solution or feeding tank in which the chemical solution is kept ready for use and from which the chemicals are delivered to the softening tanks as required for treatment. The batch or mixing tank is 4 ft. in diameter and 4 ft. high and is equipped with hinged metal covers to prevent the escape of dust from the chemicals when mixing. The solution tank is 8 ft. in diameter and 8 ft. high, having a chemical solution capacity sufficient for 12 hours' treatment. The agitating system for the chemical tanks consists of paddles mounted on a vertical shaft and revolving hori-

zontally in each tank, affording a means of mixing the dry chemicals with water in the batch tank and maintaining a uniform solution in the feeding tank. These paddles are driven by an electric motor through bevel gears, and are so arranged that the agitation in the batch tank can be discontinued without interfering with the operation of the agitators in the feeding tank. The upper tank is arranged with a valve so that a batch of chemicals can be admitted to the feeding tank at any time. This arrangement of a separate batch and feeding tank permits the preparing of a charge of chemicals in advance of the time when it is required and avoids interruption to the feeding of chemicals and other troubles that often occur when the chemical charge is mixed directly in the solution tank.

The untreated water and the chemical solution are brought together in the mixing chamber immediately below the constant level tank. After the chemicals have been added to the water it passes through a horizontal trough 8 ft. long by 4 ft. wide where the flow is intercepted for the purpose of mixing by a series of baffle plates. The water then drops over three tiers of diaphragms in the upper portion of the downcomer and passes to the bottom. From this point it rises to the top of the treating tanks where it is drawn off by means of collecting troughs. These troughs extend across the settling tank on each side of the downcomer, the purpose being to insure a uniform drawoff from all sections of the tank and avoid cross-currents having a tendency to prevent the full utilization of the settling space.

After treatment the water passes through two gravity

sand filters to a clear well from which it is pumped to the storage tanks. These filters are standard gravity filters 16 ft. in diameter by 8 ft. high. A manifold is placed in the bottom of each tank with brass strainers uniformly spaced over the entire area of the bottom of the tank. A bed of coarse gravel 6 in. thick is placed directly over the strainers and another layer of finer gravel 8 in. in thickness above the coarse gravel with a top layer of filter sand 24 in. thick above the gravel. The rate of filtration is 2 gal. of water per min. per sq. ft. of filter area. The water is admitted to the filters through a circular distributing trough which effects an even, quiet delivery of water to the filter beds. The delivery of water to the filters is controlled by float valves which prevents overflowing the filter tanks. The filter wash lines are so arranged that the filters can be washed with treated and filtered water.

The chemical storage, pumps, treating plant machinery and filters are housed in a brick building 30 ft. by 80 ft. A room 28 ft. by 30 ft. is provided for chemical storage, the remainder of the building being used for the pumps, chemical machinery and tanks and the filters. A treated water reservoir of reinforced concrete, having



The Power Head on One of the Pumps

a capacity of 40,000 gal. is constructed under the south end of the treating house. The water flows by gravity through the filters to this reservoir and is pumped to the storage tank by pumps located immediately above it.

Three rehandling and service pumps are installed in the treating house and so connected that any one or all of the pumps may obtain their supply either from the large reservoir or from the treated water reservoir, and discharge either into the treating tanks or into the discharge line to the storage tanks. The pumps are 6-in.

single-stage horizontal split-case enclosed-impeller bronze-fitted centrifugal pumps, each having a capacity of 750 gal. per min. Each pump is direct connected to a 40 hp. synchronous motor operated on 3-phase, 60 cycle, 440 volt current. Each pump is provided with an automatic control panel equipped with remote float and push button control, together with overload, high voltage and no voltage protection.

Automatic Control Provides for All Emergencies

The untreated water is obtained from two sources, the deep wells and the reservoir. Under normal operating conditions the water is pumped from either of these



The Filters Are of the Gravity Type

sources to the treating tanks from which it flows by gravity through the filters to the clear well under the chemical house. From the clear well it is pumped by the rehandling pumps to the roadside storage tanks.

The untreated water supply is controlled by three electric float switches located in the shop storage tanks and a similar switch in the north yard tank. The north yard float switch is paralleled with the first float switch in the shop storage tank so that when either or all of these tanks have 8 ft. of water removed, the switch will close and start well No. 1. If the water level should fall farther in the shop tank, switches Nos. 2 and 3 will operate wells No. 2 and 3.

Owing to the comparatively small amount of water used in the north tank, a single float switch will operate the pumps to supply sufficient water. In an emergency and by means of cross connections in the electrical control and by-pass arrangement in the water mains, it is possible to use one of the horizontal rehandling pumps in the chemical house as an untreated water supply pump.

The control of the rehandling pumps under normal conditions is quite similar in that three float sump switches are located in the clear well, operating at 2, 3½ and 5 ft. When the water in the clear well rises to a height of 2 ft., rehandling pump No. 1 is cut in automatically and supplies treated water to the roadside tanks. Should the height of the water in the clear well continue to rise, pump No. 2 will be cut in and No. 3 if the water should then rise sufficiently to trip the switch at 5 ft.

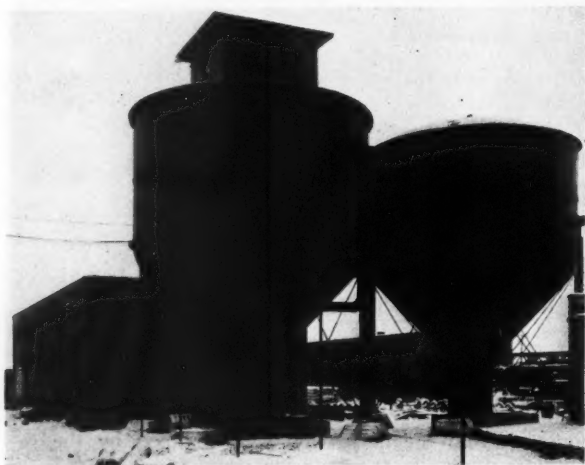
Provision on the control panel is also made so that it is possible to control any of the three rehandling pumps from any of the sump switches or the storage tank control switches. This is accomplished by means

of a large tumbler switch which is located at the bottom of the left hand control panel. A desirable feature of this control is that although the motors are all operated by 440 volt current, the control circuits are only 110 volts, giving an added feature of safety to its operation.

The Plant Has Three Attendants

The automatic features of the plant are especially beneficial in reducing the amount of attendance required for keeping the plant in running order. At Clinton the attendants are three in number, two repairmen, who give part time only to the pumping plant, and one treating plant operator. One of these men is in attendance during each eight hour shift.

Water is supplied from the reservoir to the pumps through a 10-in. wrought iron suction line. A swing joint is placed on the end of this suction line where it enters the reservoir and a 10 in. foot-valve is provided. The end of the suction line is supported by a four-post tower constructed of 8-in. by 8-in. timbers driven into



The Softening Tanks with the Filter House in the Back-ground

the bottom of the reservoir. The pipe lines in connection with the new water station and water softening plant are quite extensive, consisting of 6,800 ft. of 10 in. cast iron pipe, 2,200 ft. of 8 in. cast iron pipe and 200 ft. of 6 in. cast iron pipe. The discharge lines from the deep well pumps to the water softening plants are 10 in. lines. Each discharge from the deep well pump is equipped with a 10 in. horizontal flanged end check and gate valve just outside the pump house. A 10-in. cast iron line is also laid from the water softening plant to the storage tanks at the shops, the line extending to the north yard being 10-in. for a portion of the way and 8-in. for the remainder. The 6 in. cast iron line is laid from the water softening plant to the boiler wash-out plant for the purpose of providing treated water for refilling locomotive boilers with treated water after washout.

Recording Gages Included

In addition to the control panels a marble gage board of the same size and design as the control panels has been installed. This board is equipped with two combination indicating and recording gages suitable for working pressure up to 100 lbs.; two 30 in. vacuum gages for showing suction lift; two combination pressure altitude gages suitable for pressure of 100 lb. or 230 ft. and an eight-day clock. One vacuum gage is piped to the clear well suction of the pumps in order

to give the vacuum indication for any or all of the pumps when they are pumping from the clear well. The other vacuum gage is piped to the reservoir suction in such manner as to give vacuum indication for any or all of the pumps when pumping from reservoir. One combination indicating and recording gage and pressure and altitude gage is piped to the 10-in. header supplying the roadside tanks. Thus it is possible to check the performance of the pumps at all times, the recording gages furnishing a permanent record of the time pumps are operated as well as a record of the pressures maintained.

Plant Has 300,000 Gal. Storage

The existing storage tanks at Clinton consisted of two A.R.E.A. standard 100,000 gal. wooden tanks constructed of creosoted material, one tank being located at the shops and serving the engines entering and leaving the roundhouse, while the second tank was located at the north yard, serving freight engines entering and leaving the yard as well as the Amboy district. Since 75 per cent of the water is used at the shops, an additional storage tank with a capacity of 100,000 gal. was constructed immediately adjacent to the shop tank. These two tanks in addition to the tank in the north yard, which is of the same size and design as the other two, provide a total storage capacity of 300,000 gal. or sufficient water to supply the shops and other facilities for a period of about eight hours without pumping. While this is not an exceptionally large storage for a consumption of a million gallons per day, the pumping facilities are provided with standby units and there is little if any likelihood of failure of the water supply.

The treating plant house, with the exception of the chemical storage room, is heated by steam from the stationary boiler plant at the shops, full radiation being provided for maintaining a temperature in the treating house of 70 deg. with a steam pressure of 2 to 5 lb. per sq. in. Radiation is also provided in the headhouse over the treating tank.

The work was undertaken under the general supervision of F. L. Thompson, chief engineer of the Illinois Central, with Joseph E. Nelson & Sons, Chicago, handling the general contract for the water softeners, pipe lines, pumps and storage tanks, the Chicago Bridge & Iron Works, Chicago, constructing the steel tanks and the Sickel Water Production Company, Aurora, Ill., developing the wells.



The Excavation of Cuts in Frozen Gravel on the Alaska Railway Calls for Rock Work Methods

Proper Scheduling of Track Work Promotes Efficiency*

Performance Records of Work Under Plans in Use Show Justification of Efforts in this Direction

By G. M. O'ROURKE,

Roadmaster, Illinois. Central, Carbondale, Ill.

A SUCCESSFUL schedule, or program, of maintenance of track must be based on a knowledge of the fundamental needs of the district or division to be treated. This may possibly be secured by the roadmaster or division engineer in motoring over the track, but is established more positively by walking in company with the supervisor and each section foreman and discussing with them the requirements to place the track in the standard of repair desired within a stated period. Cross ties that are to be renewed should be carefully inspected and counted, and the time that has elapsed since the last general surfacing ascertained and duly considered in fixing the amount of surfacing needed during the working season for which the plan is being made. The number of rail anchors needed, the condition of tie plates, spikes and bolts; the drainage and strengthening of embankments, unstable roadbed conditions, and other local features effecting a schedule must be gone into thoroughly. The main track rail program and side track repairs are elements for consideration in fixing the program.

At the end of each section a conference may be held with the foreman for the purpose of fixing the number of days he can devote uninterruptedly to general work and the date on which he can commence it, depending on the condition of line and surface at the time of inspection. The number of men needed to perform the work laid out within a fixed period of time, measured roughly on past performances, is also settled upon.

With the aforementioned knowledge of conditions one is well prepared to lay out the season's schedule, although absolute planning is not possible because of soft spots in roadbed, traffic conditions, weight or rail, curvature, grades, etc.

Gain the Foreman's Interest

It is always advisable to draw from the foreman, by the power of suggestion, his plan for doing the work. If conditions will allow the acceptance of the foreman's plan it will tend to raise his morale and self respect. A better morale, once established by such a heart-to-heart discussion of conditions on each section, may be maintained by not permitting construction work to interrupt or interfere with his maintenance work; by supplying enough proper tools, motor cars, push cars, pony ballast cars, ballast ties, rail and fastenings to enable him to proceed with his work without delay, and by developing friendly rivalry through weekly or monthly reports, grading the foreman upon their accomplishments.

Inertia of foremen in getting started often delays the execution of a well defined plan. Supervisors must see that the schedule is properly despatched and not put off from day to day. Some foremen find it easier to let things go along as they are than to organize and despatch a plan. Many practical trackmen do not readily accept systematized planning and measuring of their

work. They do their work in different ways; some are efficient and economical without any apparent exertion, others who are sometimes known as hustlers are inefficient having been developed from gangs located at as many different places and composed of men who have secured their knowledge of track work in a disconnected school of experience, localized within the bounds of the section on which they are employed. Foremen fairly well advanced in skill, dexterity and judgment in the application of labor, have followed very different plans in the general conduct and direction of it; and those plans have not been equally favorable to the volume of their product. Without proper gang organization and willing cooperation a feasible program cannot be carried out.

We must bear in mind that the average foreman is not a peculiarly gifted man. We hear that this one is talented and able. These terms are relative only and unless that foreman is really superior to the vast majority a well planned schedule will overcome the differential and the work of all will be more nearly uniform.

A mediocre performance will be obvious when all are working on the same schedule and can be observed more readily by the supervisor who must thoroughly understand that deviation from the plan on this and that pretext will not be tolerated. The supervisor must go over the plan again on the first of each month, and decide upon the work for the month after considering the amount done to date and remaining to be finished within the allotted time. He must insist on perfect execution of the plan, bearing in mind that a perfectly executed slipshod plan will bring better results than slipshod despatch of a perfect plan. Lack of enthusiasm and adaptability on the part of the supervisor will prevent the successful execution of the most perfectly thought out plan. The abundance or scantiness of local labor is the deciding factor in determining whether the necessary work shall be done with section gangs, or imported extra gangs, or both.

Co-operation of Superior Officer of Advantage

A well formulated plan established as described in the foregoing brings the work under centralized control and may be placed before the management with assurance of favorable consideration in the distribution of the maintenance appropriation. If consistent it is very helpful to have the district engineer or corresponding superior officer accompany the road master. His advice in the field and help in making a report of conditions to the chief maintenance officer is of great assistance. On the Illinois Central a district engineer has jurisdiction over three or more divisions, ranging from a few hundred miles of track to upwards of a thousand; therefore it is not possible always to secure his help, although, he may be able to cover a portion of every division each year, working slowly enough to observe the effect fully,

*A paper presented before the Maintenance of Way Club of Chicago on May 14.

and not expecting results too soon. Considerable time may be required on a large division for this plan of work to be absorbed.

We now have a plan or schedule established. It is based on a careful first-hand study of the relation of cause to effect. We shall follow it up carefully to be sure no ties are removed that may last another year in the track; that all usable material is again used and not thrown into the scrap bin; that work trains are requested only when the necessity for them is beyond question; that tools are supplied in accordance with an approved list posted in the tool houses. In fact, we are going to operate in accordance with every recognized economy. The scrap bin on each section is inspected and the other elements of economy are discussed with each foreman in turn as his section is covered.

The Advantage To Be Gained

The foreman and supervisor assure us that the schedule can be completed satisfactorily if they are allowed the force recommended, but to be sure of its effectiveness labor must be applied systematically. However, to decide upon the work necessary to operate the property properly and to divide it into sections and assigned gangs is not enough. We should further divide and measure the work or task of each. The great increase of the quantity of work which the same number of men are capable of performing in consequence of the division of labor is due to three different circumstances: first to the increase of dexterity of each workman; second, to the saving in time which is commonly lost in passing from one kind of work to another; and last, to the invention of machines or devices which facilitate and abridge labor, enabling one man to do the work of many.

The improvement of the dexterity of the track laborer necessarily increases the quantity of the work he can perform; and the division of labor, by reducing every man's work to some one simple operation, necessarily increases the dexterity of the workman. Second, the advantage which is gained by saving the time commonly lost in passing from one job to another is much greater than we should, at first thought, be apt to imagine it. Third, everyone must appreciate how much labor is facilitated and abridged by the application of proper machinery. No work should be done by hand which can be done with machinery. Full use should be made of ditchers, rail loaders and layers, tie tampers and motor cars. These machines must be kept in first class repair. When they are out of service the railroad is losing money.

Bearing in mind that the labor cost of maintenance runs as high as 65 per cent of the whole it is incumbent upon maintenance officers to know through exhaustive study that the methods and gang organization are correct. On the Illinois Central the output of ordinary section gangs is measured daily through entries on a monthly form showing the amount of each class of work done during the day and the man-hours consumed. Originally a set of standards was set up which is being adjusted as the reports, spread over a long period of time, indicate errors.

To analyze the work of a large specially assigned extra gang requires the attention of an observer in the field to make time studies of each element of the whole job and, assembling this data, to set up a standard which will indicate not only the work to be performed by each individual but the number of men who will work most economically as a gang on that particular kind of work, whether it be rail laying, surfacing or other heavy operations. Having such standards, the performance of that

and similarly organized gangs may be measured very readily.

These are the fundamental principles of the science of economics as applied to track maintenance and will unquestionably result in speeding up the work and thus effect a monetary saving. This plan is a proved method and the Illinois Central is confident of results. There are many other elements of economy to be considered in the execution of a season's maintenance program, such as strong cooperation with the transportation department, through which one track of a two or more track system may be secured for uninterrupted work for certain periods of time each day; the use of local freight trains in distributing materials; a reduction in the speed of trains, making it unnecessary to make such refined preparations for their passage. In seeking such assistance, however, it must be borne in mind that the principal function of a railroad is the handling of cars and that from an economical standpoint it is probably always better to interfere with the work of maintenance than to delay trains.

Defects in Maintenance Cause Several Accidents

THE Bureau of Safety of the Interstate Commerce Commission has issued a number of reports during the past month giving the results of investigations which it has made of a number of accidents to trains which have resulted from defects in roadway and structures. Abstracts of those reports, which will be instructive to engineering and maintenance officers, follow:

Passenger Train Derailed on Defective Track

A six-car passenger train was derailed on the Chicago-Omaha main line of the Chicago, Milwaukee & St. Paul near Portsmouth, Iowa, on March 6, resulting in the death of one employee and the injury of eight passengers, two employees and three trespassers. The derailment occurred on a three degree curve on which the track was laid with 90-lb. rails, 33 ft. in length, with an average of 20 ties (90 per cent being hardwood) to the rail length, single-spiked, tie-plated and ballasted with 8 in. to 12 in. of gravel and cinders. The train was traveling at a speed of between 35 and 45 miles per hour at the time of the accident, all of the cars leaving the track and three of them falling on their sides.

The evidence showed that the derailment was caused by bad track conditions. The general roadmaster stated that heaving had reduced the superelevation at this point. With this condition prevailing the weight of trains was thrown against the outer rail, widening the gage $1\frac{1}{2}$ in., as indicated by the tie plates, and as the gage was already $\frac{1}{2}$ in. wide at the point of the accident, this permitted the left trailer truck wheel to drop inside the low rail, turning the outside rail over and resulting in the derailment.

An examination of the track on the curve on which the accident occurred showed 17 ties, or approximately 10 per cent of the total, to be decayed, 28 or about 9 per cent of the tie plates broken, 7 ties not spiked in the north rail and 8 ties not spiked in the south rail. Within a distance of 77 rail joints (approximately one-half mile) west of the point of the accident, 17 joints were found in the north rail with no spikes in three successive ties, 43 joints with no spikes in two successive ties and 12 joints with one tie not spiked. In the south rail there were three joints in this distance with no spikes in three successive ties, 37 joints with no spikes in two

successive ties and 15 joints with one tie not spiked. Rail creeping had bunched the ties in a number of places, either shearing the spikes or pulling them out. In addition to the large number of joint ties not spiked, there were many others which appeared to be placed in the track last year and not spiked and a number of spikes loose enough to be pulled out with the fingers.

The report concludes with the statement that "the large number of defective ties, together with improperly maintained super-elevation, loose and missing spikes and generally bad track conditions will not permit the safe operation of trains at high rates of speed over this portion of track. Speed restrictions should be placed upon this track until it is placed in proper condition for the safe operation of trains over it.

Train Strikes Washout

About 8:50 a. m. on March 29 a freight train on the Baltimore & Ohio went through a bridge near Locust Grove, Ohio, resulting in the death of four employees and the injury of two employees. The bridge in question was a pile trestle 111 ft. long and 15 ft. high, consisting of both frame and pile bents spaced about 18 ft. apart, supporting I-beam stringers. The bents consisted of about eight piles driven to a penetration of approximately 17 ft. The ends of the bridge were protected by bulkheads, retaining embankments of dirt and cinders about eight feet high.

There had been a heavy rainfall in the vicinity of this bridge during the preceding afternoon and night with a total precipitation of 2.1 in. This resulted in the creek being swollen to such an extent that it overflowed its banks and large trees were uprooted and washed down stream. These trees and other driftwood, lodging against the trestle, diverted the water towards the western end of the bridge and apparently undermined the roadbed for 6 to 15 ft. back of the bulkhead. The train in question, which was the first to pass over the structure for eight hours, was running at a speed of about 10 miles an hour with orders to look out for high water. The engine and seven cars went into the creek, knocking down eight bents of the bridge and breaking piles off below the water line.

The track supervisor and the section foreman, who were on the train, stated that no trouble had ever been experienced with high water at this point. The foreman had passed over the structure at four o'clock on the preceding afternoon. The pile bents and the bulkhead had been renewed in 1920 and were last inspected about 40 days prior to the accident, at which time they were found to be in good condition.

Rail Cut Ties Cause Broken Rail

A passenger train on the Central Vermont was derailed near Bolton, Vt., on March 11, killing three passengers and injuring 69 passengers and two employees. The accident occurred on tangent track on an embankment 16 ft. in height with 80-lb. rails, 33-ft. in length, laid on an average of 19 oak and pine ties to the rail length and ballasted with gravel. The accident was apparently caused by a broken rail, a section of which, 7 in. long and 7 ft. from the receiving end, was broken into small pieces.

The report of the engineer-physicist of the commission indicated that the rail was partially or completely overturned outwardly at the time it broke. It further appeared that this rail was twisted along the intermediate portion of its length. The fractured surface showed no evidence of structural defects in the rail and the accident was attributed to track conditions in the

vicinity. The ties were quite generally cut at the base of the rail, reaching a maximum of nearly three inches. Wooden braces were installed in places on both tangents and curves. This condition led the engineer-physicist to attribute the cause of the rail fracture to insecure track structure in which rail-cut weakened ties constituted a chief factor.

Concrete Ties on Pennsylvania Show Long Service Life

THE PENNSYLVANIA has had a number of armored concrete ties in a test installation under heavy traffic which now have a life of 16 years and are still in good condition. This installation, numbering 15 ties was recently removed in changing over from 100-lb. to 130-lb. steel and after some slight repairs to a few were returned to service.

These ties were designed by L. J. Riegler, assistant engineer, in 1907, and consist essentially of two steel shells enclosing a reinforced concrete filler. The steel members are shaped to perform the double purpose of protecting the concrete from abrasion by the ballast and of acting as a beam to increase the stiffness of the tie.



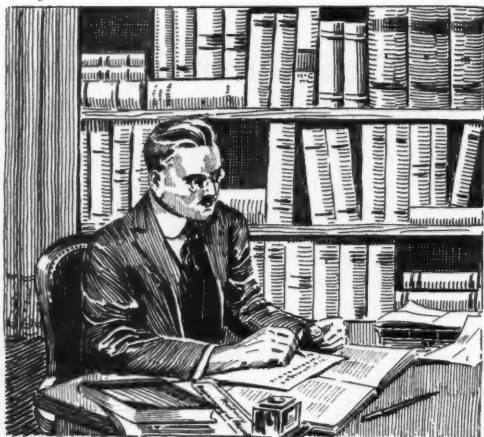
A Group of Seven Ties, Two of Which Have Been Repaired

Fifteen of these ties have been in the Pennsylvania tracks at Emsworth, Pa., since May, 1908, and from 1908 to 1914, they were subjected to a heavy, high speed, passenger traffic. In 1914, they were placed in another main track where they are subjected to a heavy freight and high speed through passenger traffic. All of the ties are still in the track. The ties at first supported 85-lb. A. S. C. E rail, which was changed to 100-lb. P. S. in 1910. The 100-lb. rail was laid without changing the fastenings, but when the change was made from 100-lb. to 130-lb. rail in 1921, it was necessary to plane off the clips holding the rails to the ties. This could have been done without taking the ties from the track, but it was considered desirable to remove the ties temporarily, as it would give an excellent opportunity for thoroughly inspecting them and noting their condition after 13 years' service under the heavy tonnage.

While all of the ties are still in service a few have, from time to time, failed by cracking or wear of the concrete, requiring repair. During the 16 year period, five of the ties have been repaired by cutting out some of the concrete and refilling. Two were repaired while in the track and three while out of the track.

RAILROAD ATHLETE.—The American Olympic Rugby team, now in Europe to compete for the world's title, includes F. Williams, assistant engineer on the Northwestern Pacific at Eureka, Cal.

What's the Answer?



This department is intended to help our readers secure answers to the questions which arise in their work in the maintenance of tracks, bridges, buildings and water service. An endeavor will be made to answer promptly by mail, any questions received. Such questions as are of general interest will also be submitted in these columns for further discussion. *Railway Engineering and Maintenance* solicits the co-operation of its readers in answering the questions which are published.

Questions to be Answered in August Issue

1. Where manholes are built in engine terminal drainage systems should the sewer line be broken at each manhole and a drop provided or should the line be continued through?
2. Does the employment of a tie inspector to aid the section foremen in spotting ties for renewal promote uniformity in tie renewals? Is the employment of such a person to be recommended?
3. What is the best form for a permanent pile driving record?
4. Should a supervisor be expected to examine scrap before allowing it to be loaded for shipment to prevent the inclusion of usable material?
5. Is it practicable to make repairs to membrane water proofing on solid floor bridges without suspending traffic, and if so, how may it be done?
6. What is the most economical way of mowing the right-of-way?
7. What is the most suitable size of a concrete mixer for general maintenance and smaller construction projects?
8. Under what conditions is the plowing of fire guards along the right-of-way advisable? What measures may be adopted to secure the plowing of these guards at minimum expense?

Center Dump vs. Side Dump Cars for Ballasting

When distributing gravel ballast for resurfacing and tie spacing after laying new rail does it require less labor per mile to unload the ballast with center dump cars or with side dump cars?

Except for the statement of J. J. Hess, general roadmaster of the Great Northern at Seattle, Wash., who is of the opinion that the nature of the work and the place where most of the material is required must determine the answer to this question, it is the unqualified opinion of all those officers who have expressed themselves on this point that it requires less labor per mile to unload ballast with center dump cars than with side dump cars. The statement of W. J. Hosceit, vice-president of the Rodger Ballast Car Company, Chicago, whose opinion was requested in view of his wide experience in ballasting work, is illuminating in this connection.

"The question asked refers only to the relative merits of the center dump cars and side dump cars with respect to the labor required to unload the ballast. While this is not the only point to be considered, the cost of unloading ballast for resurfacing and tie spacing after laying new rail is very much less with center dump cars than with any other method so far attempted. I am assuming, of course, that the ballast is to be unloaded from a properly designed car, such as will distribute free running ballast material uniformly in one heap over

the center of the track, free of the rails, so that all danger of derailment is eliminated and likewise the necessity of plowing off the rail under each car, also that the car is of such a design as to unload the ballast in sufficient quantity to raise the track from two inches to six inches and, further, that the design is such that all of this work can be done by one man and a train crew handling anywhere from 1 to 30 cars in a train, and that the train is followed by a properly designed spreader with flanges knocking down the heap after the train has been unloaded or during the process of unloading.

"If the ballast is handled according to this method, not only is the cost of labor for unloading less but it should be possible to jack up and tamp the track without any additional cost other than the actual labor cost for raising, tamping and lining, since by this method no casting of ballast material into the center of the track is required nor should any trucking of the ballast material be required.

"On the other hand, if ballast material is placed entirely outside of the rails, no matter how uniform is the distribution, at least one-half and more likely two-thirds of this material must be cast in between the rails before the resurfacing can be done. Since cars of the type specified have actually been developed and observed while in service, it is only a matter of using cars of this type to accomplish the results stated."

The statement of W. T. Collins, yard foreman on the Union Pacific at Junction City, Kan., is also of value in this connection as outlining a method of undertaking

the work where no plow is available. Mr. Collins' statement follows:

"In resurfacing track after new rail has been laid or at any other time when it becomes necessary to make a general lift of the track, center dump cars should be used and a ballast plow sent to distribute the ballast from the center of the track to the side. If no plow is available it is recommended that a tie, notched to the required depth, be used for the spreading work. A much more uniform job will result from this method of doing the work than can be obtained by using side dump cars, which also require considerably more handling of the ballast to secure the standard condition of dressed track. The plow or notched tie can be set to any required depth so as to leave a correct amount of ballast in the track and so as not to interfere with the spacing of the ties and the tamping and lining. If a light rise is to be given the track it should be surfaced and placed in proper condition before the ballast is distributed from the center dump cars and special care should then be given to unload and plow off only the amount required to dress the track properly."

Preparing for Floods

What precautions and preparations should be made in the spring by bridge maintenance forces to prevent or prepare for damage to bridges and culverts as a result of flood waters?

In no phase of the duties of the bridge maintenance officer is thorough preparation more essential than in meeting the emergencies which come with the occasional freshet or periodic high water in the streams which are carried under the railroad by bridge, trestle and culvert openings. Of primary importance is a thorough and detailed knowledge of all the structures under the supervisor's charge. Some structures are very much more susceptible to damage from high waters than others. Therefore the supervisor must know which of the bridges and trestles are in a more serious condition in order that he may concentrate his supervision at these critical places. It is only with a thorough knowledge of these conditions that he is able to interpret the reports which come to him from the various men who are assigned to patrol the structures during times of danger.

While he must have a detailed personal knowledge it is not safe for him to rely on his memory alone. He should have a complete record of pile penetrations at all of the structures so that he may judge of the seriousness of the conditions produced by scour.

Preparations for trouble implies definite measures in a number of directions. It covers definite steps to keep all waterways clear and free of refuse that would tend to block the waterways through the gathering of debris against piers and trestle bents. It also includes the preparation of a complete inventory of all materials which would be required for repairing damage that actually takes place. The supervisor should prepare a record of all bridge timbers and piles in stock on the division, together with its location, the location and condition of all bridge repair equipment, including pile drivers, bridge derricks, tools, etc. Arrangements should be also made that will insure the prompt delivery of rip rap stone, sand bags, etc., when these are needed. Another requirement is the issuance of complete instructions for the patrolling of structures which will insure thorough co-operation between section and bridge foremen in connection with this work.

As soon as the water begins to rise men should be detailed at the critical points to keep ice, brush or other floating material from lodging against the upstream sides of the structures. Where conditions demand, sounding should be taken and as it is difficult to do this in deep or fast water it is necessary to insure that men of adequate skill and experience are assigned to this work. If the water is not too deep or too swift this may be done readily with poles, otherwise, it is necessary to provide suitable sounding leads with adequate lengths of fine wire to get reasonably accurate results.

Protection of the bridge against damage from flood waters is not concerned alone with the maintenance of a clear waterway and the security of the bridge substructure, but it also implies the protection of the bridge embankments to insure that these are not eroded to an extent that will endanger them or cause them to be washed out at the rear of the abutments. It is, of course, impossible to provide structures at all water way openings that are absolutely secure against all possible flood conditions since this would entail prohibitive expenditures. Therefore, with the construction and maintenance of railway waterway openings within the limits of reasonable expenditure it is to be expected that some structures will be seriously endangered by occasional flood conditions and it is through proper vigilance and adequate preparation that the bridge supervisory officer must insure that damage, when it does occur, will be attended with minimum losses to the property.

Placing Gravel Ballast for Second Track

Which is the more economical when building new second track parallel to the main line; to place the gravel ballast with side plows equipped with long wing spreader and then to place the new track on top, or to lay the new track first and apply the ballast with center dump cars?

In answering this question it is essential to take into consideration the conditions under which the work is done. What these conditions are may be gathered from the following statement of E. Keough, assistant engineer maintenance of way, Canadian Pacific, Montreal, Que.

"If the existing track is a rock ballasted line which does not need additional ballasting at the time of building the new second track, certainly no reason can be given for unloading new ballast from this track with which to build the second track, for, unless up-to-date equipment is used of a character to permit unloading with a minimum waste of ballast, the process will result in the scattering of the new ballast over and around the existing tracks.

"On the other hand, where the existing track does require ballasting work, as is often the case, much good can be accomplished by unloading the ballast from the old line ahead of the track laying work on the new line. This is especially true if the work is done during the wet season and the new roadbed is soft, since there is less likelihood of forming water pockets in the new subgrade by operating ballast trains over the track before the ballast is applied. There is a growing practice at present, however, when ballasting a new line, to secure a somewhat impervious material for sub-ballast in order to avoid the water pockets which are often formed when new, clean ballast is applied direct to the sub-grade. If this is done, it will usually be found best to unload such subgrade material direct from the new track rather than to risk fouling the old track ballast by employing the spreader method.

"Traffic conditions are also to be considered in work

of this kind and it is not only frequently found impossible to unload ballast from the existing line but it is frequently cheaper to carry out the new grading entirely apart from the existing line in order to avoid delays to traffic."

R. Rossi, extra gang foreman, on terminal construction work, on the Illinois Central, is also of the opinion that under ordinary conditions the gravel ballast for the new line should be unloaded with center dump cars after the track is laid, Mr. Rossi confining himself to the statement that it is preferable to use the spreader for building up the subgrade of the new track before the track is laid but that to apply the ballast in this fashion not only results in the waste of much ballast but also in an increased cost of labor in gathering up the ballast on each side to fill in the track.

A further expression in support of the use of center dump cars for this purpose is contained in the following statement from J. J. Hess, general roadmaster, Great Northern, Seattle, Wash., who raises, however the additional question of bent rail.

"It is thought most economical to apply ballast with center dump cars, making two lifts of the track, which causes less settlement than where ballast is spread in advance of track laying. There is also less waste of ballast down the bank and less delay to ballast trains where traffic is heavy. One good feature of the spreader method, however, is the preventing of bending of the rail, often arising on work where sufficient care is not taken to secure a smooth and uniform finish on the surface of the subgrade. As against the advantage to be obtained from this, however, it has been found difficult to determine correctly the amount of ballast required to secure the finished job."

That the method of ballasting by the use of the center dump car is usually to be preferred is also the opinion of W. J. Hosciot, vice-president, Rodger Ballast Car Company, Chicago, whose statement outlines in considerable detail the proper method of carrying out the work to avoid some of the troubles mentioned above. Mr. Hosciot's statement is abstracted as follows:

"I am convinced that where the new second track is to be raised, tamped and lined, the method of depositing the ballast material in the center between the rails is by far the most economical. The method of dumping ballast at one side of a car and applying the same over the new second track with a long wing spreader is very expensive, since this has to be done ordinarily with a Lidgerwood machine involving the stretching of a heavy cable over the loaded train, and the use of a heavy top plow with also considerable switching and delay to the actual ballasting work, to which is to be added the expense of a spreader and the heavy cost of repairs to cars resulting from the strain created in forcing material through the side doors of the cars on one side. Furthermore, ballasting from the main line often results in delays to traffic and similar troubles.

"Where the center dump method is employed it may be found necessary, after bringing the subgrade up to a reasonably smooth surface and laying the track thereon, to tamp a few suspended ties before operating the ballast train over the new track. But if this is done the ties will give sufficient bearing to allow the operation of the train without any danger of the rails becoming surface bent.

"It is important, of course, to conduct the ballasting work in a proper manner to get the best results. After the first run of ballast is plowed off evenly with the top of the rail the track should be raised, tamped and lined, following which the track remains skeltonized and is

ready for a second raise. If this is not required, the second run of ballast can be used for dressing in which case, if all the ballast is deposited between the rail by center dumping and then spread, all that remains to be done is to cast out that portion of the ballast remaining above the top of ties or, if a modern center and side dumping car is used, the required amount of dressing can be deposited at the center between the rails and to each side as required and the spreading completed with shovels."

Gongs for Motor Cars

Should motor cars be equipped with gongs or other warning devices for use when approaching highway crossings?

The opinion on this subject is divided, some favoring the use of gongs for this purpose, others opposing it. That there are reasons in support of each opinion as well as factors to be considered in arriving at a conclusion which might readily be overlooked will be brought out most effectively by presenting the following statements received on this subject.

Against Gongs

In my judgment there is no good reason why motor cars should be equipped with gongs or other warning devices for use when approaching crossings. In districts where the traffic at crossings is dense, cars should approach and pass over the crossing at a speed which will enable the operator to stop, if necessary to avoid accidents. I believe that the general use of gongs or warning devices on track motor cars would tend toward the operation of such cars at excessive speed when passing over crossings and a corresponding increase in accidents. Furthermore, when the number of closed automobiles which cross the railroad tracks are considered it is a serious question if audible signals of any kind are of much value.

P. J. McANDREWS,

Roadmaster, Chicago & North Western, Sterling Ill.

Against Gongs

Motor cars should not be equipped with gongs or other warning devices for use when approaching highway crossings. A crossing is for the joint use of the railroad and the public. Priority of use is given the railroad for the movement of its trains on the theory that it would be unfair to slow up or stop a train containing a large number of passengers in order to permit a vehicle on the highway, occupied by a few people, to pass. Another consideration is the one of cost, there being practically no expense involved in stopping and starting a highway vehicle at a crossing, whereas, the cost of stopping and starting a train is great. Then there is the indisputable fact that it would be impossible to operate railroads if it were necessary to stop at crossings in order to give vehicles the right-of-way. But what applies to trains at crossings does not apply to track motor cars. While it certainly would be a convenient arrangement to have track motor cars given the right-of-way at crossings, the exercise of this right would, even if lawful, promote animosity against the railroads.

It is my belief that every track motor car should approach every grade crossing under control and be fully prepared to stop in the same manner as every driver on the highway is supposed to approach every crossing prepared to stop. The adding of gongs or other warning devices to the equipment of motor cars would be an incentive to the operators of these cars to attempt to

take the right-of-way from vehicles on the highway which is inadvisable from either the standpoint of safety or the effect on the public attitude toward the railroads.

W. S. WOLLNER,

General Safety and Welfare Agent, Northwestern Pacific, San Francisco, Cal.

For Gongs

It is my belief that motor cars should be equipped with a warning device for use not only at the highway crossings but for use in passing persons who may be walking along the right-of-way. By sounding a gong their attention could be attracted, thereby preventing the likelihood of their stepping on the track in the way of the car. It is dangerous to pass any one along the railroad on a motor car unless the attention of the parties being passed is obtained. By sounding a gong the operator could ascertain whether or not a person is on the alert while if no gong is sounded and the wind is blowing in the wrong direction, the car might run up so close as to frighten the pedestrian in which case he will be as apt to jump on the track as anywhere else.

C. W. MYERS,

Carpenter Foreman, Illinois Central, Durant, Miss.

For Gongs

The question as to whether motor cars should be equipped with gongs or other warning devices for use when approaching highway crossings, directly involving as it does the personal safety of both employees and the public, must be considered in a broad way, entirely free from biased opinion or preconceived notions. Four primary arguments are commonly advanced against the adoption of such devices. In answer to these arguments and as reasons for the adoption of the devices, there are likewise four arguments of an affirmative nature which should be paired with those on the negative side as follows:

Against

1. The doubtful effectiveness of any reasonably intense audible warning device.
2. Cost of installation and difficulty of perfect maintenance.
3. The difficulty of exacting universal compliance with rules for their use.
4. The very grave danger of creating in the minds of employees who use them the conviction of universal superiority of motor cars over automobiles at crossings, thus minimizing the necessity of approaching the crossing under speed restrictions.

To decide the question, it remains only to assign the proper relative weight to the foregoing arguments.

The first argument fails completely in the light of the answer. No equipment should move along the track without some means of announcing such movement, regardless of the noise the equipment may create by reason of its motion. This is both a written and unwritten law in the railroad world. Besides, a reasonably intense as well as distinctive audible warning can be provided.

The second argument opposing the use of gongs must be given some consideration, for while the cost of application to an individual unit may be trifling, the aggregate

For

1. No equipment should be moved along the track unless it carries efficient devices to warn of its approach.
2. The humanitarian aspect of waste of life and limb justifies any reasonable expenditure and constant precaution.
3. The public in its use of the highways is entitled to at least equivalent exactions from the railroads as are demanded from it by the railroads.
4. The importance and volume of automobile traffic on the highways justify reciprocal measures of equality, however difficult to enforce.

cost of equipping the very large number of motor cars in use will produce a sum of no mean proportions. As for the difficulty of maintenance in perfect working order, it must be assumed that only the simplest kind of device should be installed in order that the operator of the car can without assistance and with little or no cost, keep the device in working order at all times. If, however, there is any likelihood at all of avoiding personal injury or death, as unquestionably there is, the financial argument against the device loses much of its weight and the balance drops sharply on the affirmative side.

The pros and cons of the third argument are so nearly of equal weight that it may be canceled. We say to the driver of the automobile, "Stop! Look! Listen!" True, he doesn't do it. But if he did stop, the conditions of the surrounding country at many important crossings is such that the motor car, built as low as it is, could not be seen at any great distance. Nor could it often be heard when approaching from the leeward direction. However, the point in the argument is just this: Are we willing to admit that we cannot secure from employees better observance of rules than we expect from the automobile driver over whom we have no control? No railroad man will make any such admission, but on the contrary will most emphatically declare that once the employees are keenly alive to the situation, prompt compliance generally if not universally is assured. A sense of fairness demands that we eliminate this third contention entirely.

Disposition of the fourth argument is hardest of all. As between motor cars and automobiles, vehicle for vehicle, the motor car should have the superior right at crossings because with equal speed it necessarily requires a longer braking distance to avoid a collision. Viewed thus, this very argument against warning devices becomes the strongest one in their favor. The widespread use of automobiles throughout the country forces the conclusion that, except in isolated cases, automobile traffic on the highway is superior to motor car traffic on the railroad and must be so recognized by everyone. While the difficulty cannot be entirely overcome, it can be greatly diminished by making it plain to motor car operators that the gong or warning device is merely an adjunct to speed and control regulations at crossings.

Thus it appears that although some of the arguments against the adoption of warning devices cannot be hastily brushed aside, yet the preponderance of weight is for their adoption. There would seem to be little doubt as to the correctness of a conclusion in favor of such devices.

ARTHUR RIDGWAY,

Chief Engineer, Denver and Rio Grande Western, Denver, Col.

Loosening Tank Hoops for Painting

Should the hoops of water tanks be loosened before painting the tub?

First Answer

Hoops made from round iron are considered more desirable for water tubs than those made from flat iron. In case such hoops are used, the preservation of the wooden staves by painting is not materially interfered with by leaving the hoops intact, since there is but little surface of the tank that cannot be painted. In cases where flat hoops are used, any protection that may be afforded the wood work by means of painting is over balanced by the injury to the holding qualities of the tub, brought about by the loosening of the hoops. It is

the thought, therefore, that the hoops of water tanks should not be loosened before painting the tub.

C. B. CLEGG,

Supervisor Water Service, Atchison, Topeka & Santa Fe, Amarillo, Tex.

Second Answer

The proceedings of the American Railway Engineering Association and the American Railway Bridge and Building Association contain considerable information bearing on the question of the loosening of the hoops of water tanks previous to painting the tub. When discussing the repair and maintenance of tank hoops, a committee of the Bridge and Building Association found it advisable to discuss the merits of different types of hoops somewhat at length, during which the following statements were made with regard to flat hoops: "A serious objection to flat hoops is the fact that a satisfactory inspection cannot be made without removing them from the tank, due to the fact that they often rust or corrode on the inside and become thin and weak without any apparent deterioration from the outside. Cases have been reported where tanks equipped with flat hoops have collapsed a few days after a superficial inspection has been made. Regardless of these facts, few roads seem to have standard instructions for the inspection of tank hoops, especially flat ones, and the hoops are seldom removed unless they show some indication of weakness on the outside when the tanks are painted. The tanks are painted every two or four years, and more often if appearance requires. In nearly all cases, however, the hoops are well painted both inside and out, and the connections oiled or painted before the tank is erected, which, of course, is proper and is done with good results. Only two lines (out of 45 railways) were found to have specific instructions for the removal of flat hoops for inspection. These instructions required the removal of all hoops every year in one case and every two years in the other case, at which time all hoops are scraped and painted."

This report contains a further statement that, "Almost without exception it is the practice when erecting tanks, to apply at least two coats of paint to both the inside and outside of hoops, usually using red lead for the first coat and the hoops being well cleaned before painting." This committee found, however, that on the 45 lines reporting on the subject, 25 had practically adopted the use of round or half round hoops and reported as one of the advantages that a more satisfactory and thorough inspection could be made of the hoops.

During the discussion of this report, it developed that the Baltimore & Ohio has general instructions for the removal of the hoops every time a tank is painted, whereupon the defective hoops are renewed and all hoops are re-painted on the under side, the outer face of the hoop then being painted when the tank is painted. These hoops are of the flat type. At the same time reference was made to certain instances where old wrought iron hoops had been in use 25 to 35 years without ever having had anything done to them except painting on the outside when the tank was painted at regular intervals.

The proceedings of the American Railway Engineering Association also refer to hoops, where one reason given for the adoption of the round hoops as standard is the ready detection of any deterioration of the hoop and the ability to paint practically the whole surface of the hoop without loosening it.

These extracts from these proceedings are sufficient to establish the importance of the type of hoop used in determining whether or not they should be loosened

previous to painting the tank. It should be remembered, however, that the loosening of the hoop is not alone to be considered as a means of inspecting the condition of the hoop but also as a means of determining the condition of the staves. There has been considerable difference of opinion regarding the protection of the tank staves from deterioration, but it may safely be said that the chief consideration in the loosening of flat hoops is to determine the condition of the hoops rather than the staves, for it is doubtful whether any great benefit is derived from painting the outside of water tanks except for the sake of appearance, unless, of course, the tank is filled with water only a portion of the time and this is a condition which should not be allowed, except under the most unusual conditions.

The Way to Remove a Tie

What is the best way to remove a tie?

First Answer

Probably the common practice when spotting in ties is to remove the ballast from between the tie to be renewed and one next to it, and knock the old tie into this trench which is dug to a depth below the bottom of the tie sufficient to allow easy handling. This is not the best practice, however, because any disturbance of the old bed is undesirable.

The foreman should make a careful inspection of and mark the ties to be removed for some distance ahead of his work. He should measure their depth and select ties of the same size for insertion and have the latter laid opposite those to be renewed. Only enough ballast should be dug from around the tie to be removed to prevent its bed being covered with loose ballast when it is withdrawn. Mechanical wear under the rail and ballast wear on the bottom of the tie may reduce its depth to less than the usual size of a new tie, in which case the bed may have to be cut down enough to accommodate it. Such cutting must be carefully done because the most important condition to be obtained is to get the new tie in place with a neat, tight fit requiring little or no tamping. As many ties can be renewed by the latter method as by the former because the time consumed in thoughtful preparation is often exceeded by the time required to handle the extra ballast and complete the tamping where ties are "hogged" out. There are no objections to nipping the rail slightly to remove a tie if the ballast is of sufficient stability to stand and the track will not be humped. However, sometimes this is a dangerous practice and it should only be done by men of considerable experience and ability.

Where ties are very much decayed many can easily be torn to pieces with a pick and removed with no disturbance to the ballast. Some track men made this a regular practice and do not remove ties that resist such attacks because they are probably good for another year or two of service. Of course, no tie that has another year of life in it should be removed.

From the personal injury viewpoint the following excerpt is given from an article written by roadmaster P. Glynn of this road.

"When old ties are being taken out, the track men should never stand in front of the tie that is being taken out for the man pulling the tie out is liable to throw it against his leg or foot. The men should stand on each side of the tie, stick the pick in the middle of the tie and place one foot on the rail and both pull together. Where the pick holes are near the rail the picks should be changed to the outside when the final pull is given."

All spikes should be promptly withdrawn from old ties and those fit for further use redriven. Too often many spikes are found buried in the ashes where ties were burned. The care of usable spikes and scrap is a part of the job of renewing ties. Ties removed from track should not be burned until inspected by the roadmaster or superintendent.

The removal of ties while surfacing is simple. While the track is raised for general face work I believe the best method is described in the above quotation from roadmaster Glynn's article.

G. M. O'ROURKE,
Roadmaster, Illinois Central, Carbondale, Ill.

Second Answer

The cardinal point to be borne in mind when renewing ties is that the old tie bed and the ties adjacent to it should be disturbed as little as possible. With enlarged section forces or extra gangs, I prefer the jacking out method pursued upon the following lines: After marking the ties that are to be removed, the tops of all the rail-cut and uneven surfaced ties are trimmed so that the surface of the tie will be level with the base of the rail, thus removing any roughness which would tend to interfere with its withdrawal. The material at the ends of the ties being removed, the ballast which skirts the length of the tie should be loosened and drawn clear with the picks, leaving a V-shaped opening on both sides and throughout the length of the tie. This prevents material from slipping in under the tie during its withdrawal and causing the tie to be come bound against the rail and thus necessitate further jacking.

The spikes are then withdrawn from the tie to be removed and slackened in the one next to it. The jacks are inserted between these two ties and the track is jacked up sufficiently, but at no time to a greater height than $\frac{3}{4}$ -in., to permit the removal without allowing material to run in under the adjacent ties. It is important to slack the spikes in the tie next to the one removed, otherwise when the track is raised this tie will also be raised off of its original bed and the downward pressure exerted by the jacks will force material into the opening under the tie so that, upon releasing the jacks, the tie will not return to its original bed, thus causing humped track. The further precaution must be considered at this time of preventing the men from tramping on the ballast between the ties, which, if permitted, will disrupt the ballast formation and force additional material under the suspended ties.

Having taken these precautions the tie plates should be removed, then one of the men should drive his pick into the end of the tie while the other takes a bite in the tie on the gage side of the rail with a finely sharpened lining bar. With their combined efforts the tie is readily removed. Should a bar of this nature be lacking, both men should sink their picks in the end of the tie and after several short forward and backward moves to release it from any binding forces that may exist, the tie is drawn out in a single pull.

When none of the authorized section forces are employed, and there are but a few ties to remove, I prefer using two track spikes or blocks of similar thickness in the place of jacks. After cutting away all surface irregularities from the face of the tie and loosening and removing the ballast as described above, the spikes are slackened in the neighboring ties, the rails sprung by means of a claw bar and the spikes or blocks of wood inserted between the rail and the tie on both sides of the track. With this amount of extra clearance the tie is readily extracted.

I have found the jacking out method to be the most

expedient, practical and economical in either stone, gravel or dirt ballast. Many assert that this method is impracticable in dirt or ballast tracks on account of the material running in under the ties when the track is jacked up. This is true only where ballast is sandy or new in which case the ties are generally new and require but few renewals. But ballast, no matter how sandy, which has been in the track for a year becomes more or less fouled and attains a wall like formation along side of the ties. The straight upward lifting exerted by the jacks in this case does not disturb these wall like formations.

Records of the writer in connection with both methods of tie removal show that a 50 per cent increase can be attained by employing the jacking out principle in rock, while in dirt or gravel ballast double the results can be obtained than by the digging out method.

F. LISTON,
Canadian Pacific, Vaudreuil Station, Que.

Repair Parts Allowed Pump Men

How large a stock of repair parts should be carried in stock by pump repair men?

First Answer

I have found that the satisfactory operation of certain types of pumps and engines requires that an extra part, such as a piston or cylinder head, must be kept at certain stations. However, as a rule, all standard fittings and parts are kept at the storehouse and may be sent to the station where needed by passenger trains on instant notice, thus making it unnecessary for the pump repairman to carry an extensive stock of parts or supplies. This has been found to be the most satisfactory method of handling parts, where the territory of the repair man is as large as a grand division.

A. W. JOHNSON,
Supervisor Water Service System, Atchison, Topeka & Santa Fe, Topeka, Kan.

Second Answer

The question of the amount of stock of repair parts that should be allowed repair men does not admit of a definite answer for the reason that conditions are seldom alike in any two places.

It is important, among other factors, to consider the pump repairer himself because of the special type of men usually required for this work. Pump repairing is not work for which an ordinary repair man is suited. Good pump repair men are rare. They are men who not only must have an aptitude and a decided liking for the work but who can be relied upon not merely to put in the usual day's schedule of time but rather to keep the pumps going under any condition. Where such men are found it is usually the better plan not to restrict them by too many rules concerning their work but to leave it largely to the superior officer to use his judgment in each case.

However, it is a fact that where no rules are imposed, even the best pump repairers are likely to accumulate stocks of parts far beyond their actual needs. Some repair men, for instance, have been found to be literally maintaining a small storehouse, considering the amount of piping, batteries, valves and general equipment carried in stock at one or more places. This has developed a rule on some roads that only those repair parts should be carried in stock which are intended for immediate use on specified equipment. This rule is sound since it is based upon the principle that if a pump repairer is on the alert he should be able to anticipate his needs sufficiently in advance of the time when the repairs must

actually be made to secure the equipment from the storehouse. According to a like arrangement it is required that repair men carry in stock only those company tools which are necessary for the usual work, such as six-inch pipe dyes, etc., being carried rather by the division water supply gang or kept in stock at some central point where they can be sent immediately upon request for any unusual work that arises. The answer to the question, therefore, seems to be not so much a specification of the tools and equipment which pump repairers should be allowed to handle but rather to outline the general principles which should govern. It is true that where a pump repairer is intent upon carrying a large stock of tools he can find many ways of abusing the rule but this can be prevented by an occasional inspection on the part of the superior officers.

Providing Carpenters with Tools

To what extent should carpenters be expected to provide their own equipment and tools?

First Answer

A carpenter should be expected to furnish his own tools to the full extent of his ability as a carpenter. Carpenters are, as a rule, very partial to their tools and take great pride in their care. For this reason and many others it would not be satisfactory for tools to be furnished the carpenter which he cannot select and own. I have been following the carpenter trade for about 25 years and you could not induce me to use any other tools but my own. A grade of tools that I have been using all my life might not suit the other fellow. Most carpenters demand the very best make of tools, and tools that are backed up by years of service. If railroads or any other corporation should contemplate furnishing carpenter tools they would find themselves confronted with trouble. A check system would have to be maintained in order to give an accounting of the tools and for this reason alone, it would not be practical.

Carpenters, however, should not be expected to furnish such equipment as trestle benches, work benches, mechanical scaffolding, power machinery, etc. Their equipment should be confined to carpenter tools only.

C. N. MYERS,

Carpenter Foreman, Illinois Central, Durant, Miss.

Second Answer

Some roads furnish more equipment of certain kinds than others and some roads again are more liberal in the supply of small tools. The supervisor has a great deal to do with the matter and on him depends to a great extent just what is furnished. Sufficient camp cars should be provided by the railroad to take care of the needs of the crew according to the class of work performed and to insure ample room so that the cars will be kept neat and sanitary.

The necessary equipment inside the tool and material cars to take care of such tools and materials as will be carried in them can be provided by the crew, the company furnishing the material. The equipment in the dining and bunk cars, should be divided between the company and the men. The men should not be required to furnish steel bunks, mattresses, kitchen range, cooking utensils and dishes but should furnish their own blankets, sheets, pillows, pillowslips and towels. The amount of covering required by one man may be entirely insufficient for another. Some men want larger pillows than others, for instance, and if supplied by the company discord might arise.

Carpenters should not be expected to furnish the

motor and push cars, chains, blocks and lines, winches, vices, post-hole diggers, shovels, concrete hoes, picks, crowbars, cant hooks, carrying hooks, cross-cut saws, axes, and any other tools and equipment of this kind. There are many reasons for this. In case of the motor car he has no other use for it than as a means of getting to and returning from work. The other tools mentioned are ones that are not used frequently and if furnished by the men would not be suitable at all times. Then again if a man quit the foreman might find himself handicapped for the want of some tools not possessed by any of the other men or if they all had these tools they would have a surplus of some and not enough room to take care of them. Moreover, many able men who follow the building work on railroads move from place to place. If required to furnish these tools they would look for some other class of employment and it would be next to impossible to get carpenters.

Carpenters should furnish all small tools for bridge and building work such as ship augers up to 13/16 in. where 3/4 in. bolts are the standard, also adzes, squares, saws, hammers, chisels, etc., in fact, such small tools as the average house carpenter uses. No two men are of the same temperament, neither do they handle their tools alike or take care of them in the same way. If tools were furnished by the company they would be common property and each man in the crew would feel that he had as good a right to use them as any other. This would result in serious discord. JOHN P. WOOD, Supervisor Bridge and Buildings, Pere Marquette, Saginaw, Mich.

Third Answer

A carpenter in a construction and maintenance gang of a railroad should furnish about the same kit of hand tools that would be required if he were employed by a contractor and builder. However, since railroad work is especially hard on tools of all kinds, the carpenter should be given an opportunity to replace at no cost to himself tools lost or destroyed through no fault of his own.

Gang foremen should be provided with certain tools for the rough work, such as hand axes, coarse hand saws, ripping chisels, nail pullers, etc., in addition to the usual heavy tools also the men should be furnished by the company with all tools necessary on account of conditions found in railroad work not usual to the carpenter trade. These conditions vary so greatly with different roads and different divisions that no set rules can be made that will apply to all, or nearly all.

I believe that the carpenter's kit should be so condensed that it can be carried in a small shoulder box and should not exceed the following:

| | |
|------------------------------------|---|
| Thumb gage | Countersink |
| Spoon bits | Set of extension lip bits up to 3/4 inch or 1 inch. |
| Screw driver bit | 1 1/2 inch and 2 inch framing chisel |
| Expansion Kit | Steel square |
| Set of firmer chisels up to 1 inch | Adjustable bevel |
| Ratchet brace | Seven or eight point cross cut saw |
| Tri-square | Compass saw |
| Rip saw | Small screw driver |
| Twelve point cross cut or pony saw | Adjustable spirit level with plumb |
| Spiral screw driver | Chalk line scratch awl, etc. |
| Extra heavy screw driver | Smoother plane |
| Plumb bob | Claw hammer |
| Jack plane | Saw set |
| Block plane | Adze |
| Hatchet | |
| Oil stone | |
| Compasses | |

C. W. WRIGHT,

Master Carpenter, Long Island, Jamaica, N. Y.

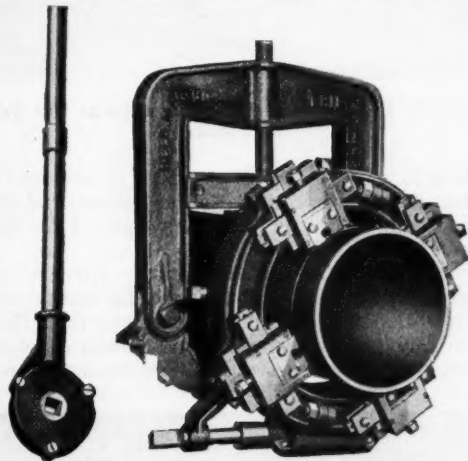
New and Improved Devices



A Ratchet Pipe Cutter

IN recent years there has been a noticeable effort to make the work of cutting and threading pipe of the larger sizes less troublesome and expensive. Indicative of this are a number of tools and other forms of equipment which have appeared upon the market for work of this kind. One of the most prominent of these developments is a form of pipe cutter which is operated on the ratchet principle, as distinguished from the familiar type of cutter which is moved bodily over the surface of the pipe by handles on the sides.

This type of tool has recently been further modified by the development of three large sizes of pipe cutters



The New Beaver Pipe Cutters

which are rotated by means of a stationary driving pinion rather than by the ratchet. As the illustration shows, this driving pinion is fixed to one side of the cutter and extends outward at right angles to the line of the pipe. This pinion has a square end so that a ratchet handle may be slipped into position with which to turn the pinion. The force on the pinion is transmitted to the cutting knives through an enclosed worm gear whereby the pipe may be cut or threaded simply by successively pushing the ratchet handle downward, the operator standing in one position.

The outstanding advantage of this construction is that it enables one man to cut pipe as large as 12 in. in diameter as distinguished from the common method which requires two men on pipe of this size. In places where a large quantity of pipe is being cut the construction of the cutter is also such as to make it possible to operate the machine by power, rather than by the use of the ratchet handle. In addition to the convenience with which the pipe can be cut or threaded with these cutters

it is also said that the operation can be performed much more quickly than usual.

The threader in question is known as the Beaver pipe cutter and is manufactured in three sizes by the Borden Company, Warren, Ohio, size No. 106 being adapted for 2½ in. to 6 in. pipe, size No. 108 for 4½ in. to 8 in. pipe and size No. 112 for 9 in. to 12 in. pipe. Except for this method of operation, the construction of the cutter is similar to other cutters of this line, a further feature of which is the type of cutting knife which is so constructed as to prevent it becoming broken in the process of cutting. The cutters are also designed to insure a square end cut. The feeding of the cutter during the operation is automatic.

New Spike Maul Given Severe Test

FEW track tools are subjected to more severe service than a spike maul. This is particularly true when they are used to strike track chisels, although their use for the purpose of driving spikes calls for a tool of high quality. In an endeavor to provide a spike maul which will give the longest possible life, the Warren



A Close Inspection Showed No Sign of Deterioration After a Severe Test

Tool & Forge Company, Warren, Ohio, has perfected a new model, known as the "Slug Devil."

This maul is made of carbon chrome steel, which alloy was selected after a long period of experimental work with various alloys, the chrome being chosen because of its effect in producing the toughness desired to withstand the severe wear and tear by track mauls without mushrooming. The heat treating of the maul is done

in electrically controlled furnaces, which feature insures a high degree of uniformity in the quality of the metal. Under this method of heat treating the maul is said to receive an unusual depth of face hardening, as compared with the plain carbon maul.

To determine the service that can be expected from these mauls a 10-lb. sample, taken from stock, has been subjected to an extended service test. This consisted in using the maul to strike many successive blows on the heads of track shisels and cold cutters, using one face of the maul only. Periodically, during the test, the maul has been taken out, gaged with a micrometer and examined carefully for checking, chipping or spreading. At the time this information became available, 201,000 blows had been given, as tabulated below:

| | |
|---|---------------|
| 39,000 or more track chisels and cold cutters were struck three blows each. | 117,000 blows |
| 28 special test chisels, 3,000 blows each... | 84,000 blows |
| Total | 201,000 blows |

A careful examination of the maul at the end of the 201,000 blows failed to disclose any effect on the test face which would offer indications of deterioration such as would result in spreading or chipping.

Combination Heavy Duty Crane and Pile Driver

THE Brown Hoisting Machinery Company, Cleveland, Ohio, has recently built for the Northern Pacific a combination heavy duty crane and pile driver, which may be revolved through a complete horizontal circle and will drive piles at any point on the entire circumference at a 32-ft. radius. As shown in the illustration, the machine is equipped with an exceptionally long truss that permits the hammer to operate at a distance of 21 ft. 10 in. ahead of the front axle of the car.

In cases where it is necessary to drive at or above the track level, the pile driver is so equipped that either a steam or drop hammer may be used as desired. With the use of outriggers the machine will handle piles weighing up to 6,400 lb., together with a steam hammer of the

same weight. Piles may be driven at a maximum batter of $3\frac{1}{2}$ in. to the foot. The leads are battered through a train of hand-operated gearing and are held in any desired position by a locking pin in order to relieve the bearings of the load. This batter may be varied on either side of the center and nine positions are available. The leads may be quickly and compactly folded to come within clearance limits for transportation. A special wedge support is provided under the truss and holds it securely when the driver is being moved in a train.

The car itself is 25 ft. 6 in. over the end sills and has a total length over the couplers of 29 ft. 6 in. The total



The Driver in Position to Drive Batter Piles at One Side of the Track

wheel base is 20 ft. 4 in. The truss is so arranged that it overhangs a flat car coupled to the forward end of the pile driver car. The full working weight of the equipment is 241,000 lb.

In order to make the change from pile driver to crane, the truss is swung over a car on a parallel track, or over a platform alongside the car, and blocked up. The removal of four pins from the top and bottom chords, and the ropes and the piping for the steam hammer effects a

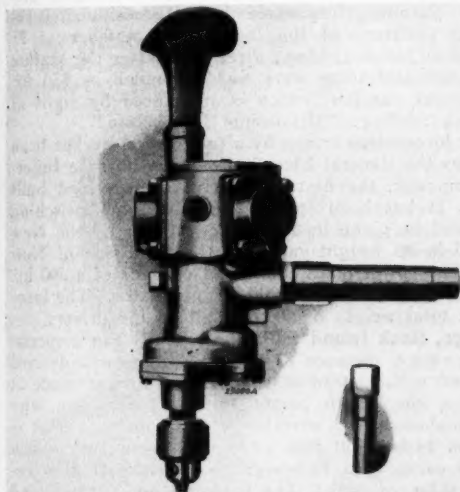


Long Trusses Provide for Driving 21 ft. 10 in. Ahead of the Front Axle

complete disconnection of the driver equipment. A locomotive crane boom is then attached in the usual way by blocking it up at the proper level ahead of the crane and running the car up to it. The cables are attached with quick acting rope clamps and after the boom has been reeved, the head end is raised by the crane's own power. Arrangements have also been made so that the boom sheaves may be removed without relieving the strain on the lifting cables.

A New Light Weight Pneumatic Drill

A NEW lightweight, non-reversible pneumatic drill has recently been developed by the Ingersoll-Rand Company, New York, for the light drilling of holes up to 9/16 in. in diameter and the reaming of holes up to 5/16 in. in diameter. It is arranged to be fitted with either breast plate, feed screw or grip handle to cover



The New Ingersoll-Rand Drill

a wide variety of work. A feature of the unit is a special three-cylinder motor utilizing cast iron cylinders which are renewable and interchangeable, thus making it possible to replace any cylinder quickly and easily when that is needed. It is housed in a lightweight aluminum case with steel bushings cast in all the bearing holes and the throttle hole. It's recommended working speed at 90-lb. air pressure is 700 rev. per min. The total weight with breast plate and chuck is 14 lb. and the overall length is 15 in. Using the feed screw, the length of feed is 2 1/2 in.



A Concrete Blanket to Protect the Roadbed, on the Santa Fe in Southern California

The Material Market

WITH a further falling off in the demand and in spite of an appreciable curtailment of production, prices continue to soften. The reductions are now more definitely manifest in the quoted prices than was the case a month or two ago. As a result we now find that the prices for iron and steel items are in general on a level with those that which obtained in February and March, 1923, while lumber prices at the mills are now practically equivalent to those prevailing in July, 1922. Current quotations on maintenance of way scrap which represent much greater reductions than those which have taken place in new material, are now practically on a level with prices obtaining in May and June, 1922.

Concurrent with reductions in demand, appreciable reductions have taken place in the production of iron and steel which, as a general average, is now said to be about 65 per cent of capacity. But in spite of reduced output, the volume of orders on hand is decreasing, as indicated by the well known index represented by the unfilled orders of the United States Steel Corporation, which totaled 4,208,447 tons at the end of April as compared with 7,288,509 tons a year ago. Current reports show a fair volume of new orders for track materials and the specifying of considerable material against orders placed with the mills earlier in the year. Current quotations of iron and steel items are as follows:

PRICES IN CENTS PER 100 POUND

| | April 20 | | May 20 | |
|---|----------------|--------------|------------------|--------------|
| | Pittsburgh | Chicago | Pittsburgh | Chicago |
| Track spikes | \$3.00 | \$3.10 | \$2.90 to \$3.00 | \$3.10 |
| Track bolts | \$4.00 to 4.25 | 4.10 | 3.75 to 4.25 | 4.10 |
| Angle bars | 2.75 | 2.75 | 2.75 | 2.75 |
| Tie plates, steel | 2.25 to 2.60 | 2.60 | 2.55 | 2.60 |
| Boat spikes | 3.25 to 3.50 | 3.59 to 3.84 | 3.25 to 3.40 | 3.59 to 3.74 |
| Plain wire | 2.75 | 3.09 | 2.65 to 2.75 | 2.99 to 3.09 |
| Wire nails | 3.00 | 3.34 | 2.90 to 3.00 | 3.24 to 3.34 |
| Barbed wire, galv. | 3.80 | 4.14 | 3.70 to 3.80 | 4.04 to 4.14 |
| C. I. pipe, 6 in. to 12 in., per ton | | 56.20 | | 55.20 |
| Plates | 2.20 to 2.40 | 2.50 | 2.20 to 2.25 | 2.45 |
| Shapes | 2.30 to 2.40 | 2.50 | 2.25 | 2.45 |
| Bars, soft steel | 2.25 to 2.40 | 2.40 | 2.20 to 2.25 | 2.35 |
| Rivets, structural | 2.65 to 2.75 | 2.99 to 3.09 | 2.65 to 2.75 | 2.90 |
| Open hearth rail, per gross ton, f. o. b. mills | | | | 43.00 |

As mentioned above reductions continue in the prices of scrap.

PRICES PER GROSS TON AT CHICAGO

| | April | May |
|------------------------------|--------------------|--------------------|
| Relaying rails | \$27.00 to \$32.00 | \$27.00 to \$32.00 |
| Rails for rerolling | 16.50 to 17.00 | 15.00 to 15.50 |
| Rails less than 3 ft. long | 17.00 to 17.50 | 17.00 to 17.50 |
| Frogs and switches cut apart | 14.50 to 15.00 | 14.25 to 14.75 |
| Steel angle bars | 16.50 to 17.00 | 15.50 to 16.00 |

Further reductions are appearing in the prices of lumber as a direct result of the unfavorable relation of production to demand. Reports of the Southern Pine Associations show that mill orders on hand for the week of May 9 total 219,000,000 ft. b. m. as compared with

SOUTHERN PINE MILL PRICES

| | April | May |
|------------------------------------|---------|---------|
| Flooring, 1x4, B and B flat | \$46.20 | \$45.90 |
| Boards, 1x8, No. 1 | 38.40 | 34.60 |
| Dimension, 2x4, 16, No. 1, common | 28.15 | 26.65 |
| Dimension, 2x10, 16, No. 1, common | 29.80 | 28.55 |
| Timbers, 4x4 to 8x8, No. 1 | 28.90 | 30.20 |
| Timbers, 3x12 to 12x12, rough | 38.40 | 39.35 |

DOUGLAS FIR MILL PRICES

| | April | May |
|-------------------------------------|-------|-------|
| Flooring, 1x4, No. 2, clear flat | 32.00 | 32.00 |
| Boards, 1x8, 6 to 20, No. 1, common | 19.50 | 17.50 |
| Dimension, 2x4, 16, No. 1, common | 17.50 | 16.50 |
| Dimension, 2x10, 16, No. 1, common | 18.00 | 16.00 |
| Timbers, 6x6 to 8x8, No. 1, common | 23.00 | 23.00 |
| Timbers, 10x10 to 12x12, rough | 21.00 | 20.00 |

366,000,000 and 336,000,000 for the corresponding periods of 1923 and 1922 respectively, while on the west coast the production Douglas fir for the first 19 weeks of 1924 totaled 1,880,000,000 ft. b. m., compared with 1,830,000,000 for the same period of 1923, whereas orders for the first 19 weeks of 1924 totaled 1,798,000,000 compared with 2,021,000,000 for 1923.



News of the Month



The Chicago, Milwaukee & St. Paul is sending one of its largest electric locomotives on a three months' tour of the states east of the Mississippi for advertising purposes. The engine is accompanied by a coach fitted up with a lecture room, where motion pictures of the electrified trains moving through the mountains are shown.

B. W. Hooper, chairman of the United States Railroad Labor Board, was re-elected for another year on May 12. G. W. Hanger, vice-chairman was also re-elected. Mr. Hooper was appointed a member of the Labor Board in 1921, prior to which he had been governor of Tennessee.

The Baltimore & Ohio will electrify its passenger service on the East Shore division and the Perth Amboy division as rapidly as plans can be developed and the work executed. This includes the lines between St. George, South Beach and Tottenville, Staten Island. The total track mileage which will be electrified at this time is approximately 40 miles.

The Pioneer or water tunnel of the Moffet tunnel, which is to penetrate the Continental Divide on the line of the Denver & Salt Lake in Colorado, had been driven in 2,100 ft. from the east portal and 2,340 ft. from the west portal prior to May 1, while the main heading of the railroad tunnel had been driven 1,450 ft. A total of 500 men are now being employed on this tunnel.

The average daily movement of freight car for the month of March was 27.3 miles per day, according to the Bureau of Railway Economics. This exceeded by 0.3 mile the average for March, 1923, and by 3.3 miles the average for March, 1920. The average load per freight car in March was 26.6 tons, which is a decrease of 1.3 tons compared to March last year and 1.5 tons under the average for the same month in 1920.

The Reading has opened a new passenger terminal at Camden, N. J., across the Delaware river from Philadelphia which has a concourse of 323 ft. long and 100 ft. wide and houses four electrically-operated ferry slips served by 10 tracks for regular service and 4 additional tracks for use when traffic is unusually heavy, each track being long enough to hold a 14-car train. This is one of the major construction projects of the year.

To encourage the preservation of health and increase the length of life among its 211,000 employees, the Pennsylvania has issued a general notice urging every individual to undergo a complete examination as to physical condition at least once a year, this examination to be made at the company's expense. The new provisions are entirely apart from the regulations requiring train service employees and others to undergo periodical tests for sight, hearing, etc.

The campaign to be conducted by the American Railway Association to reduce the number of highway crossing accidents will begin on June 1 and will continue until September 30. Elaborate plans have been completed for the campaign with the co-operation of the National Association of Railway and Utilities Commissioners, the American Automobile Association, the National Safety Council and the National Automobile Chamber of Commerce as well as the United States Chamber of Commerce, and its various members.

The use of concrete sheet piling, provided with jets for driving, was accomplished successfully by the Illinois Central in the construction of a bulkhead 4,698 ft. long along its Stuyvesant dock at New Orleans, La. The piles were 25 ft. 1½ in. long, 36 in. wide and 10 in. thick and were equipped with an interior pipe provided with jet outlets at the bottom

and the sides of the pile. The adjoining edges of the piles were provided with a tongue and groove construction to insure proper alinement and a close fit.

A law requiring automobiles to be stopped before crossing over a railroad at grade is now in force in Mississippi, which now makes this practice the law in four adjacent states, Virginia, North Carolina, Tennessee and Mississippi. It is reported that violators of the law to the number of 75 were arrested at Jackson, Miss., three days after the statute became effective and some were fined as much as \$50 for failure to observe the law, which is announced by signs at every crossing reading: "Mississippi Law—Stop."

An electric locomotive driven by a fuel oil engine has been built jointly by the General Electric Company and the Ingersoll-Rand Company, the first locomotive of this kind built in America. It has been specially designed for switching service and will be given its first practical test by the New York Central in its freight yards on the west side of New York City. The power plant equipment consists of a 300 hp. oil engine direct connected to a 200 kw. generator. The locomotive has a total weight of 60 tons, all on the drivers.

The Chicago, Rock Island & Pacific recently ran a special train of five cars a distance of 20 miles on power derived from powdered milk instead of coal. The run was made at the request of the health commissioner of Chicago, who wished to emphasize and advertise the axiom that milk is to the human body what fuel is to the locomotive, which slogan he is using in a campaign to educate children regarding the value of milk. The locomotive was first fired with coal, but the fire was maintained throughout the run with briquettes of dried milk made especially for the occasion. The heat given off per pound of milk is almost equal to that obtained from coal.

The Class I Railroads had total operating revenues of \$505,124,921 in March, 1924, the last month of record, according to reports of the Bureau of Railway Economics. This was a decrease of \$30,701,470 or 5.7 per cent as compared with the same month of last year. Operating expenses totalled \$390,273,909 which is a decrease of \$27,653,080 or 6.6 per cent as compared with the same month in 1921. For the first three months of the year the Class I roads had a net operating income of \$202,776,047 which is at the annual rate of return of 4.61 per cent on their property investment. This compared with \$184,603,374 for the same period of 1923 when the return was at the rate of 4.56 per cent. A total of 34 carriers operated at a loss in March of which 11 were in the eastern district and 23 in the western district.

In a hearing before the Interstate Commerce Commission on behalf of 42 railroads involved in the Interstate Commerce Commission's second train control order, which requires them to install train control, the general testimony as well as that of the individual railroads was to the effect that train control devices are still in an experimental or at least a development stage, that until they are perfected they are likely to introduce new elements of danger, that most of the devices tried now are likely to be scrapped in a short time in the process of development and in bringing about interchangeability between railroads, and that to require additional installations before the result of the installations on the first 49 roads have made greater progress would cause a more or less useless duplication of expense. The railroad witnesses also contended that the expenditure required would be productive of greater results in the way of safety or operating economy if used in other ways.

Personal Mention

General

William R. Triem, whose promotion to assistant trainmaster on the Toledo division of the Pennsylvania, with headquarters at Toledo, Ohio, was reported in the May issue, was born on October 21, 1886, at Allegheny, Pa., and is a graduate of Mt. Union College and of Ohio State University, from which latter institution he received the degree of civil engineer in 1910. He entered railway service in that year as an assistant in the engineering corps on the Marietta division of the Pennsylvania, in which capacity he continued on that division and the Toledo division until 1916, when he was assigned to construction work at Delaware, Ohio. He was promoted to assistant division engineer of the Akron division in 1918, and held this position on the Akron and the Logansport divisions until his recent promotion to assistant trainmaster on the Toledo division.

J. J. Breheny, a former roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been promoted to superintendent of the Oklahoma-Southern division.



J. J. Breheny

Mr. Breheny was born on July 3, 1882, at Atlantic, Ia. He entered railway service in May, 1898, as a roadmaster's clerk on the Western Iowa division of the Chicago, Rock Island & Pacific, was promoted to chief clerk to the engineer maintenance of way of the Iowa division in 1902, and held this position until 1907, when he was promoted to assistant roadmaster of the Colorado division. He became roadmaster of the Nebraska division in 1908 and served in this capacity until 1912, when he was promoted to trainmaster of the Colorado division.

He was appointed special representative of the general manager of the Second district in September, 1923, and held this position until January, 1924, when he was appointed supervisor of operation, with headquarters at Chicago, the position he held when recently made superintendent.

Engineering

L. Andrews, chief engineer of the San Antonio & Aransas Pass, with headquarters at Yoakum, Tex., has resigned.

A. F. Dyer has been promoted to assistant engineer on the Minnesota division of the Illinois Central, with headquarters at Dubuque, Ia., to succeed **Van Arsdelan**, who has been transferred to the St. Louis division, with headquarters at Carbondale, Ill., in place of **M. B. Davis**, who has been promoted to supervisor of track at Palatine, Ill.

J. B. Raymond, whose promotion to division engineer on the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., was reported in the May issue, entered railway service in 1903 as a chairman on the Gulf, Colorado & Santa Fe. Since 1903, Mr. Raymond has served consecutively as chairman, rodman, instrumentman and roadmaster until his recent promotion to division engineer.

H. D. Pilcher, whose appointment as assistant engineer on the Wabash at Montpelier, Ohio, was reported in the April issue, entered railway service in 1913 as an employee on railway location work, in which he was engaged for one year, whereupon he became a construction inspector on the Wabash. He served one year and six months as inspector, two years and five months as draftsman and instrumentman and

two years and two months as second assistant engineer, following which he was promoted to track supervisor, the position he was holding at the time of his recent appointment to assistant engineer.

Lawrence Spalding, whose promotion to valuation engineer of the Bessemer & Lake Erie, with headquarters at Greenville, Pa., was announced in the May issue, was born on July 25, 1890, at Yonkers, N. Y., and was graduated from Cornell University in 1913. He entered railway service on July 1, 1913, with the Pittsburg, Shawmut & Northern, remaining with that road until April 1, 1914, when he went with the Bessemer & Lake Erie and served in various positions on the engineering corps and in the drafting and valuation departments. On March 1, 1916, he was appointed supervisor of structures and held that position until November 1, 1919, when he was appointed assistant valuation engineer, in which capacity he was serving at the time of his recent promotion to valuation engineer.

R. A. Cook, valuation engineer of the Chicago & Alton, with headquarters at Chicago, has been promoted to chief engineer, with the same headquarters, succeeding **H. T. Douglas, Jr.**, whose death was reported in the May issue. Mr. Cook is succeeded by **J. R. Hoagland**, principal assistant valuation engineer. Mr. Cook was born on April 6, 1881, at Lonsdale, R. I., and graduated from the Massachusetts Institute of Technology in 1903. He entered railway service in June of that year as a rodman on the Chicago & Alton. He was promoted to assistant engineer in charge of maintenance work in 1904, and in 1909 was appointed engineer in charge of track elevation and construction work, in which capacity he served until 1913, when he was promoted to valuation engineer, the position he was holding at the time of his recent promotion to chief engineer.

Carl C. Witt, whose promotion to supervising engineer of the Bureau of Valuation of the Interstate Commerce Commission, with headquarters at Washington, D. C., was announced in the May issue,



Carl C. Witt

was born on December 15, 1870, and received his engineering education at Purdue University, graduating in 1892. He was engaged as a designer of automatic machinery, gas engines, etc., with the Crane Company and the Webster Manufacturing Company at Chicago, and also in saw milling appraisal work and as a designer with the Lassig Bridge & Iron Works, Chicago, until 1899, when he entered railway service as an assistant engineer on the Chicago & North Western, with which road he continued as assistant engineer, as a chief drafts-

man of the bridge department and as an engineer on construction until December 1, 1907, when he was appointed chief engineer of the South Dakota Railroad Commission. In 1910 he was engaged in appraising the Chicago, Peoria & St. Louis for the attorney-general of Illinois in connection with the passenger rate case in that state and in May, 1911, was appointed chief engineer of the Public Utilities Commission of Kansas. He remained in this position until 1913, when he was appointed district engineer of the Bureau of Valuation of the Interstate Commerce Commission at Kansas City, Mo. He became a member of the engineering board in 1919 and upon the consolidation of valuation offices in Washington in 1921 was made assistant supervising engineer.

B. F. Dickerson, assistant engineer maintenance of way on the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Mattoon, Ill., has been promoted to office engineer, system, with headquarters at Cincinnati, Ohio, to succeed **W. B. Hodge**, who has been promoted to division engineer maintenance of way, with headquarters at Washing-

ton, Ind., as noted elsewhere in this issue. Mr. Dickerson was born on December 7, 1887, at Galion, Ohio, and graduated from Ohio Northern university in 1909, immediately following which he entered the U. S. Civil Service in the Philippine Islands and continued in this service until 1912, when he entered the service of the Cleveland, Cincinnati, Chicago & St. Louis. He entered military service on October 27, 1917, as a captain in the coast artillery and remained in this service until 1919, when he returned to the Cleveland, Cincinnati, Chicago & St. Louis as assistant engineer maintenance of way at Mattoon, which position he was holding at the time of his recent promotion.

J. A. Heaman, assistant chief engineer of the Western region of the Canadian National, with headquarters at Winnipeg, Man., has been promoted to chief engineer of the Grand Trunk Western lines, with headquarters at Detroit, Mich., succeeding T. T. Irving, whose transfer to the Central region was reported in the May issue. Mr. Heaman was born at Memphis, Tenn., on June 3, 1874, and graduated from McGill University, Montreal, Que., in 1902. He entered railway service as an instrument man on the Grand Trunk in April, 1901, and in April of the following year was promoted to resident engineer. Mr. Heaman was appointed assistant resident engineer at Toronto, Ont., in November, 1902, and a year later he was appointed assistant engineer in charge of a location party on the Grand Trunk Pacific. He held this position until May, 1905, when he was promoted to division engineer in charge of location and construction. He was promoted to assistant district engineer in November, 1906, and in April, 1911, to district engineer at Winnipeg. He was promoted to office engineer at Winnipeg in March, 1912. In August, 1912, he was promoted to assistant to the chief engineer at Winnipeg, and in December, 1917, to assistant chief engineer at Winnipeg. He continued in this capacity with jurisdiction over the western lines of the Canadian National until his recent promotion to chief engineer at Detroit.

L. B. Elliott, a member of the engineering department of the Cleveland, Cincinnati, Chicago & St. Louis, has been promoted to engineer maintenance of way on the Cincinnati-Sandusky division, with headquarters at Springfield, Ohio, to succeed **W. S. Burnett**, who has been promoted to engineer of construction, as reported in the May issue, and **W. B. Hodge**, office engineer, system, has been promoted to engineer maintenance of way, with headquarters at Washington, Ind., to succeed **E. J. Bayer**, promoted. Mr. Hodge was born on January 13, 1887, at DeGraff, Ohio, and graduated from Ohio Northern University in 1910. He entered railway service the same year as a chainman on the Cleveland, Cincinnati, Chicago & St. Louis, and thereafter served in various positions in the engineering corps until his promotion to assistant engineer maintenance of way at Wabash, Ind., in 1915. He entered the construction department in 1917 as an assistant engineer, where he served on various work, principally as resident engineer of relocation in the Miami conservancy district flood prevention work at Dayton, Ohio, until June, 1923, when he was promoted to office engineer, system, the position he was holding at the time of his recent promotion.

W. S. Burnett, whose promotion to engineer of construction of the Cleveland, Cincinnati, Chicago & St. Louis was reported in the May issue, was born on September 5, 1878, at Montrose, Scotland. After graduating from the East of Scotland Technical College, Mr. Burnett came to the United States and entered railway service as a rodman on the Southern Indiana, now a part of the Chicago, Milwaukee & St.

Paul. In 1900 he was promoted to instrumentman and he held this position until 1904, when he was appointed resident engineer on the Chicago Southern, now a part of the Chicago & Eastern Illinois. He entered the service of the Cleveland, Cincinnati, Chicago & St. Louis in 1906 as resident engineer and in 1908 became resident engineer on the Chicago, Milwaukee & St. Paul. He held this position until 1910, when he returned to the Cleveland, Cincinnati, Chicago & St. Louis as resident engineer. He was promoted to district engineer in 1912 and the following year was promoted to engineer maintenance of way at Springfield, Ohio. He was later appointed district engineer at Springfield and was holding this position at the time of his recent promotion to engineer of construction.

Track

W. W. Irving has been promoted to roadmaster on the Kansas, Oklahoma & Gulf, with headquarters at Allen, Okla., to succeed **T. P. O'Neil**, resigned.

N. E. Potter has been promoted to supervisor of track on the St. Louis terminal district of the Wabash, with headquarters at St. Louis, Mo., to succeed **A. G. Scott**, who has resigned.

Francis Anderson has been promoted to district roadmaster of the First district of the Montana division of the Great Northern, with headquarters at Wolf Point, Mont., to succeed **Peter Bjornstad**, who has been assigned to other duties.

P. Doherty, assistant roadmaster on the Michigan Central at Three Rivers, Mich., has been promoted to roadmaster, with the same headquarters, to succeed **John McConnell**, deceased.

William McDiarmid has been promoted to roadmaster on the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Manistique, Mich., to succeed **C. M. Hayes**, who has been transferred to Appleton, Wis., following the resignation of **H. P. Wood**.

M. B. Davis, assistant engineer on the St. Louis division of the Illinois Central, with headquarters at Carbondale, Ill., has been promoted to supervisor of track on the Indiana division, with headquarters at Palatine, Ill., to succeed **T. J. Flynn**, who has been transferred to the St. Louis division, with headquarters at East St. Louis, Ill., in place of **C. Miffin**, who has been transferred to Carbondale, Ill., to take the place of **H. B. Sutliff**, retired on pension.

William E. Deubel, whose promotion to supervisor of track on the Pennsylvania was reported in the May issue, was born on April 11, 1875, at Hamilton, Ohio, and entered railway service in July, 1889, as a trackman on the Cleveland, Cincinnati, Chicago & St. Louis at Anderson, Ind. He was appointed track foreman at New Paris, Ind., in 1894, but again became a trackman at Anderson, Ind., in 1895, where he remained until 1896, when he was reappointed track foreman. Thereafter he served as track foreman at Millville, Ind., and at Hamilton, Ohio, until 1923, when he was promoted to general foreman, which position he was holding at the time of his promotion to supervisor.

G. W. Blosser has been promoted to acting assistant supervisor of the Cincinnati division of the Pennsylvania, Southwestern region. **J. E. Vandling**, rodman on the Allegheny division of the Pennsylvania, Central region, has been promoted to acting assistant supervisor on the Monongahela division, with headquarters at Youngwood, Pa., to succeed **W. W. Patchell**, who has been transferred to the Pittsburgh division, with headquarters at Gallitzin, Pa., to succeed **F. R. Rex**, who has been promoted to supervisor on the Allegheny division, with headquarters at Dunkirk, N. Y., in place of **Joseph Emerling**, deceased.

William T. Wolfe, whose promotion to supervisor of track on the Pennsylvania was reported in the May issue, was born on July 23, 1881, at Richmond, Ind., and studied engineering at Earlham College, Richmond, Ind., following which he was employed in U. S. geological survey work at Taneyville, Mo. He entered railway service in December, 1905, as an assistant in the engineering corps of the Pennsylvania at Richmond, Ind., and continued in this capacity on the Rich-



J. A. Heaman

mond and Louisville divisions until 1912, when he was appointed engineer in charge of construction of a new yard and engine terminal at Richmond, Ind. Thereafter he continued in the engineering department until his recent promotion to supervisor on the Richmond division, with headquarters at Anderson, Ind.

William H. Jones has been promoted to acting roadmaster on the Illinois division of the Atchison, Topeka & Santa Fe, with headquarters at Chillicothe, Ill., to succeed **C. H. Shrier**, who has been promoted to general track inspector of the Eastern district, Eastern lines, with headquarters at Topeka, Kan. Mr. Shrier was born on May 6, 1886, at Blandinsville, Ill., and entered railway service on July 21, 1905, as an extra gang timekeeper on the Atchison, Topeka & Santa Fe. He was promoted to section foreman at East Fort Madison, Ill., on November 1, 1905, and from January 1, 1906, served as assistant extra gang foreman on the Illinois division. Until July 1, 1908, he was promoted to extra gang foreman. He was employed as extra gang foreman, section foreman and as a clerk in the division superintendent's office at Chillicothe, Ill., until February 1, 1920, when he became roadmaster on the Illinois division, which position he was holding when promoted to general track inspector.

C. R. Gates, assistant engineer on the Southern railway, lines west, with headquarters at Birmingham, Ala., has been promoted to track supervisor, with the same headquarters, to succeed **J. R. Williamson**, acting supervisor, and **J. N. Collier** has been promoted to track supervisor on the Northern Alabama district, with headquarters at Haleyville, Ala., to succeed **L. M. Johnson**. Mr. Collier was born on January 17, 1885, at Toccoa, Ga., and entered railway service in August, 1903, as a trackman on the Charlotte division of the Southern. He was promoted to section foreman in December, 1905, and continued as section foreman and extra gang foreman on the Atlanta division until 1917, when he left railway service to enter the employ of a firm in charge of double tracking. Returning to the Southern he served as a steel gang foreman until April 1, 1924, when he was promoted to supervisor of track, as noted above.

R. D. Copeland, whose promotion to track supervisor on the Wabash, with headquarters at Montpelier, Ohio, was reported in the April issue, entered railway service in 1904 as a section laborer on the Missouri Pacific while pursuing his university studies. His first railway work following his graduation began in December, 1906, as a chainman in the engineering department of the Atchison, Topeka & Santa Fe, at Chanute, Kan. He left railway service in 1908 to engage in engineering construction at Chanute, Kan., but returned in 1909 as a building inspector at Wellington and Wichita, Kan. From 1910 until July, 1918, he was employed consecutively as a laborer in the water service department, as a chainman and rodman at Chanute, Kan., as a draftsman in the general office at Topeka, Kan., and as a draftsman on construction work in California, as office engineer and assistant engineer at Cushing, Okla., and as an assistant engineer on new construction work at Brunswick, Mo., until July 1, 1918, when he entered the service of the Wabash as an assistant engineer on maintenance work at Moberly, Mo., which position he held until his recent promotion to track supervisor at Montpelier, Ohio.

Bridge and Building

H. Bly has been appointed master carpenter of the Willmar division of the Great Northern, with headquarters at Sioux City, Iowa, to relieve **William Brand** while on leave of absence.

L. F. McMaster has been appointed assistant supervisor of bridges and buildings of the Nebraska division of the Union Pacific, with headquarters at Omaha, Neb. **R. R. Bishop** has been promoted to supervisor of bridges and buildings, with headquarters at Salt Lake City, Utah, to succeed **C. S. Duncan**, who has been appointed assistant supervisor.

Purchases and Stores

W. J. Kelleher has been appointed purchasing agent of the Alabama & Vicksburg, with headquarters at New Orleans.

Construction News

The Algoma Central is building a one-mile cut-off in northwestern Ontario to allow the abandonment of two wooden trestles. The cut-off is being blasted through rock and will cost approximately \$125,000.

The Alton & Southern contemplates the construction of an extension from the present eastern terminus to Mitchell, Ill.

The Ann Arbor is reported to be planning the construction of a branch line from near Durand, Mich., to Flint, a distance of 16 miles.

The Asherton & Gulf has applied to the Interstate Commerce Commission for authority to construct a line of 208 miles from Asherton and Del Rio to Corpus Christi, Tex.

The Atchison, Topeka & Santa Fe has awarded contracts to Joseph E. Nelson & Sons, Chicago, and to the Sumner-Sollitt Company, Los Angeles, Cal., for the construction of a one-story machine shop, 180 ft. by 215 ft., at San Bernardino, Cal., to cost approximately \$200,000.

This company has been granted authority to construct, jointly with the Los Angeles & Salt Lake, the city of Los Angeles and the county of Los Angeles, a viaduct across the Los Angeles river and the railway tracks adjacent to the river at Ninth street in the city of Los Angeles, Cal. The construction of similar viaducts at Macy, Aliso, First, Fourth and Seventh streets, Los Angeles, is also planned.

This company also contemplates the construction of additions and improvements to its approach tracks in Chicago, between the western city limits and Sixteenth street, at an estimated cost of \$992,000. Plans include the construction of third and fourth main tracks between Kedzie and Wentworth avenues and at other points and a subway under its tracks at Thirty-ninth street.

This company plans the construction of an ice plant and icing dock at Winslow, Ariz.

The Canadian National plans the construction of 10 tracks, each 2,500 ft. long, at Port Mann, B. C.

The Canadian Pacific has commenced work on a new storage yard near Papineau avenue, east of Mile End station, Montreal.

The Central of Georgia has awarded a contract to the George B. Swift Company, Chicago, for the construction of a coach and paint shop at Savannah, Ga., to cost approximately \$350,000.

This company has been authorized by the Interstate Commerce Commission to revise the alignment and grades on its Columbus-Birmingham line between Opelika and Sterretts, Ala., a distance of 100 miles, including a number of changes in location and the construction of 47.55 miles of new track, subject to the condition that a continuous viaduct will be constructed in the town of Childersburg, where the line crosses that of the Southern, that a freight and passenger station at that point be relocated and that physical connection be established with the tracks of the Southern.

The Central of New Jersey has awarded a contract to the Bethlehem Steel Bridge Company for four two-track lift spans of 8,100 tons for that road's Newark bay bridge. The substructure has been awarded to the Arthur McMullen Company, New York.

The Chesapeake & Ohio closed bids on May 22 for the construction of a passenger station at Ashland, Ky.

This company has awarded to the Chicago Bridge & Iron Works a contract for the furnishing and erection of a 50,000 gal., conical bottom, steel tank at Skelton, W. Va., and has closed bids for the construction of a pumping station and the laying of a pipe line at Gladstone, Va.

The Chicago & Alton is constructing a steel bridge across the Mackinaw river at Lexington, Ill., with company forces.

The Chicago & Western Indiana has called for bids for the laying of approximately 10,000 ft. of 6 in. and 8 in. cast iron, high pressure, pipe line at Fifty-first street, Chicago.

The Chicago, Burlington & Quincy has closed bids for the construction of a passenger station at Farmington, Ill., and

has called for bids for the construction of a brick passenger station at Shenandoah, Iowa. This company has also called for bids for the construction of an interlocking tower at Aurora, Ill.

This company has awarded a contract to the Chicago Bridge & Iron Works for the construction of water softening plants at Ellsberry, Mo., Machens and Louisiana.

The Chicago, North Shore & Milwaukee Electric has acquired a 65-acre tract of land in Waukegan, Ill., on which it plans the immediate construction of shops and other terminal facilities.

The Delaware, Lackawanna & Western has awarded a contract to F. M. Talbot, New York, for the construction of an overhead highway viaduct at Mountain View, N. J., to cost approximately \$100,000. A contract has been awarded to F. D. Hyde, New York, for the construction of a mail building at Hoboken, N. J., to cost \$50,000 and to the Stillman-Delehanty-Ferris Company for the construction of a building at Hoboken to be used by the Pullman Company to cost \$55,000.

The Detroit, Toledo & Ironton plans the construction of a new terminal, including enginehouse, repair shops and related buildings, at South Charleston, Ohio.

The Florida East Coast has awarded to the American Engineering & Construction Company, Miami and Chicago, contracts for grading and pipe culvert work on 21 miles of second main track to be laid at South Jacksonville, Fla., New Smyrna and Fort Pierce.

The Grand Trunk Western has closed bids involving an estimated expenditure of \$800,000 for the construction of an enginehouse and repair shop at Battle Creek, Mich., and has called for bids for the construction of viaducts in the grade separation project at Flint, Mich., at an estimated cost of \$100,000.

The Illinois Central has awarded contracts to the Railroad, Water & Coal Handling Company, Chicago, for the construction of a pumping station and the laying of a pipe line near Madisonville, Ky., and for the construction of sand handling facilities and cinder pits at Dubuque, Iowa.

This company has called for bids for the construction of a mail terminal at Memphis, Tenn.

The International-Great Northern contemplates the remodeling of its passenger station at Taylor, Tex.

The Lehigh & New England is making active progress in awarding contracts in connection with its Tamaqua, Pa., engine terminal and yards. A contract has been awarded to F. H. Clement & Company, Bethlehem, for construction of a 10-stall roundhouse, 90 ft. deep, of brick and concrete; 18-ft. by 30-ft. oil house of brick and reinforced concrete with tanks and pumps; 31-ft. by 45-ft. boiler house of brick and concrete for two 150-hp. keeler boilers with brick stack 100 ft. high, and 16-ft. by 16-ft. transformer house. A contract has been awarded to Fairbanks, Morse & Company for a 200-ton reinforced concrete coal pocket. A Bethlehem 85-ft. twin-span turntable, concrete foundation, and a 50,000-gal. cypress tank with a 10-in. Mansfield water column are being installed and a Robertson ash-pit and hoist has been ordered. In addition to the foregoing items, a car inspection and repair building, 30 ft. by 65 ft., and an office building for terminal officers and employees, with a crew room and locker room, will be built. It is expected that these new facilities will be completed this year. The total estimated cost of the work is \$600,000.

The Missouri Pacific is preparing plans for the rebuilding of its locomotive and car shops at Fort Scott, Kan., recently damaged by fire, and has called for bids for bridge filling for twelve bridges on the White River division. The project is estimated to cost \$200,000.

The Nashville, Chattanooga & St. Louis is reported to be planning the construction of passenger stations at Lexington, Tenn., and Smyrna.

The New York Central has reached an agreement with the city of Toledo, Ohio, under which it will pay 65 per cent of the cost of constructing a subway under its tracks at Detroit avenue in Toledo. The total cost of the improvement is estimated will be \$400,000.

The Norfolk & Western has awarded contracts for steel work on two bridges in its Cincinnati district to the Mt. Vernon Bridge Company and for masonry to J. P. Pettyjohn, Lynchburg, Va., and Pitts & Morris, Roanoke, Va., respectively. A contract has been awarded for steel work on another bridge in the same district to the Virginia Bridge & Iron Works, Roanoke, and for masonry work on another to the Walton-Sudduth Company, Bluefield, W. Va. These bridges are estimated to cost, respectively, \$126,500, \$92,300, \$13,000 and \$57,300.

This company has authorized the construction of second main track as follows: Kermit, W. Va., to Crum, 9.62 miles; Big Sandy line, \$1,185,000; Wilcoe to Gary, 1.49 miles, Tug Fork branch, \$140,000; Tug to Wilcoe, 1.45 miles, Tug Fork branch, \$130,000.

The Pennsylvania has awarded contracts to the Chicago Bridge & Iron Works, Chicago, for the erection of a 200,000-gal. steel water tank with crane at Effingham, Ill., and a 300,000-gal. steel water tank at Indianapolis, Ind.

This company has awarded a contract for the construction of boiler shop No. 2 at its Juniata shops to the Columbia Construction Company, Altoona, Pa. The work will cost approximately \$45,000.

The Portland Terminal has awarded a contract to the Chicago Bridge & Iron Works for the furnishing and erection of a 50,000-gal. all-steel tank at Portland, Me.

The Reading has awarded a contract to the Curtis-Grindrod Company for the construction of a metal-covered machine shop at St. Clair, Pa., and has awarded a contract to the Robert E. Lamb Company, Philadelphia, for an addition to the office of its motive power department at Sixth and Perry streets, Reading, Pa.

This company has awarded a contract for the construction of a coal yard at Pleasantville, N. J., to the Curtis-Grindrod Company, Philadelphia. This company has undertaken extensive improvements at its South street ferryhouse, Philadelphia, including the placing in service of an additional ferry slip, the enlargement of the present ferry house, the construction of an overhead bridge across Delaware avenue, an escalator and a stairway connecting the South street station of the Philadelphia Rapid Transit's elevated line with the Reading's ferry house. The escalator will be 4 ft. wide, the stairway 6 ft. wide and the bridge 18 ft. wide. They will be built of steel to be furnished by the Belmont Iron Works. The construction will be done by company forces.

The Southern has awarded a contract to the Brimer & England, Knoxville, Tenn., for the construction of a frame freight station, 100 ft. by 34 ft., at Greenville, Tenn.

This company will construct additional trackage at ten points on its lines between St. Louis and Danville, Ky. New yard tracks, aggregating a mile and a quarter in length, will be constructed at Huntingburg, Ind., and passing tracks will be extended at Dix, Walnut Hill, Golden Gate, and Maud, Ill., Woods, Riceville and Lincoln City, Ind., Clarks and Harrodsburg, Ky. Work is also now well under way on improved shop facilities at Princeton, Ind., including a new tool room for the machine shop, and construction of a complete new planing mill with the necessary machinery.

The Southern Pacific, reported in the May issue as calling for bids for the construction of an additional 15 miles of the Natron cutoff from Oakridge, Ore., to Summit, has awarded a contract to Henry & McFee, Seattle, Wash., for the construction of six miles of the line and to Erickson-Peterson-Grier, San Francisco, Cal., for the construction of nine miles of the line.

This company, jointly with the St. Louis Southwestern, contemplates the construction of a union passenger station at Corsicana, Tex.

This company has completed plans for the construction of a freight car repair plant at Houston, Tex., and will begin construction at once. The repair plant and tracks will cover an area of 30 acres, which will be filled in to uniform elevation. Two repair yards will be built, one for heavy repairs with a capacity of 130 cars, and the other for light repairs, with a capacity of 191 cars. These yards will contain a total of approximately 45,000 ft. of track. The shop building for heavy repairs will be 400 ft. long and will accommodate four tracks. A shop and mill building, 208 ft. by 40 ft., will also

be constructed. Plans also include a shop with 3,200 sq. ft. of floor area which will be used for preparing and assembling wheels and axles. The buildings will be of slow burning mill construction covered with asbestos protected metal. The mill will be equipped with automatic sprinkler system. This company will rebuild at once its docks and freight sheds at Sacramento, Cal., recently destroyed by fire with a loss of \$250,000.

The St. Louis & Hannibal will construct a repair yard and storage tracks at Hannibal, Mo.

The St. Louis-San Francisco has awarded a contract to Cagle & O'Connell, Tulsa, Okla., for the construction of a passenger station at Bristow, Okla., reported in the March issue.

The Temiskaming & Northern Ontario has awarded a contract to Grant Brothers, Ottawa, Ont., for the construction of a line, to be known as the Lorrain branch, in Northern Ontario.

The Vicksburg, Shreveport & Pacific plans the construction of a freight and passenger station at Monroe, La.

The Wabash contemplates the construction of a freight station and warehouse at Columbia, Mo.

Western Pacific.—This company is reported to have awarded a contract to W. A. Betchel, San Francisco, Cal., for the construction of a roundhouse and car repair shop and storehouse at Stockton, Cal.

Equipment and Supplies

The Atlantic Coast Line has ordered 250 tons of steel for bridges from the American Bridge Company.

The Baltimore & Ohio has inquired for 5,000 tons of rail.

The Baltimore & Ohio has awarded a contract to the Fort Pitt Bridge Works of Pittsburgh, Pa., for the fabrication and delivery of approximately 5,300 tons of steel bridge superstructures, delivery to commence July 1.

The Boston & Maine has inquired for 200 tons of steel for bridges.

The Central of New Jersey has inquired for 900 tons of steel for a bridge at Somerville, N. J.

The Chesapeake & Ohio has placed an order for 600 tons of steel for bridges.

The Delaware, Lackawanna & Western has placed an order for 100 tons of steel for bridges.

The Florida East Coast has ordered 400 tons of bridge steel from the Phoenix Bridge Company and 850 tons from the Virginia Bridge & Iron Company.

The Illinois Central has inquired for 1,500 tons of structural steel for a transfer boat and has ordered 355 tons of structural steel from the Virginia Bridge & Iron Company for alterations and additions to its outbound freight house at Memphis, Tenn.

The Lehigh Valley has ordered 130 tons of steel from the Bethlehem Steel Corporation for bridges.

The Long Island has ordered 750 tons of steel from the Shoemaker Satterthwait Bridge Company for transfer bridges.

The New York Central has ordered 900 tons of steel for bridges.

This company has ordered a battery of floor tanks with pumps for handling lubricating oils at its oil house at Cleveland, Ohio, from S. F. Bowser & Company, Inc., and has placed an order for the equipping of two oil houses at Selkirk, N. Y., including a 20,000-gal. and a 12,000-gal. capacity cylindrical tank installed out of doors for gasoline and kerosene, large rectangular tanks installed in the basement running from 4,000 to 10,000 gal. capacity each and having standard indicators on the first floor, one gallon and five-gallon hand-operated pumps on the first floor and several outfits with power agitators for the storage and handling of mixed paints.

The Norfolk & Western has ordered 700 tons of steel for bridges from the Mount Vernon Bridge Company.

The Pennsylvania has placed orders for 500 tons of steel for bridges.

Supply Trade News

General

The Kalman Steel Company has moved its Chicago office to 410 North Michigan avenue.

The Chicago Bridge & Iron Works is planning an extension to its fabricating shop at Chicago.

The Illinois Clay Products Company has removed its main office from Oglesby, Ill., to the Barber building, Joliet, Ill.

The Sullivan Machinery Company, Chicago, has moved its Pittsburgh office to Rooms 517-520, Farmers Bank building.

The Federal Cement Tile Company has removed its offices from 110 South Dearborn street to 608 South Dearborn street, Chicago.

The Pittsburgh Testing Laboratory is now occupying its new laboratories and office building at Stevenson and Locust streets, Pittsburgh, Pa.

The Simmons-Boardman Publishing Company has opened an office at San Francisco, Cal., at 74 New Montgomery street, with Homer Beach in charge.

The Austin Company, Cleveland, Ohio, has removed its Chicago office from the Continental & Commercial Bank building to suite 1300 Burnham building, 160 North La Salle street.

The Southern Wood Preserving Company plans the immediate construction of a timber-treating plant at Chattanooga, Tenn., which will treat ties for the Nashville, Chattanooga & St. Louis and other railways entering Chattanooga.

The Bucyrus Company, South Milwaukee, Wis., has appointed the Borchert-Ingersoll Company, St. Paul, Minn., its agent for the sale of small revolving shovels and dragline excavators for the states of Minnesota, North Dakota and South Dakota.

The B. F. Nelson Manufacturing Company, Minneapolis, Minn., manufacturer of roofing, insulating papers and waterproof cotton ducks, has moved its Chicago railroad sales office to the Transportation building, 608 South Dearborn street, Chicago.

The Atlas Aluminate Cement Company, 25 Broadway, New York, a recently formed organization to acquire the Spackman patents covering the manufacture in this country of all high alumina cements, commonly known as French quick-setting cements, is now manufacturing this product at Northampton, Pa., in commercial quantities under the trade name of Lumnite.

Personal

P. E. Stouffer, assistant to the general sales manager of **S. F. Bowser & Company**, with headquarters at Ft. Wayne, Ind., has been promoted to assistant manager of the railroad department, with the same headquarters.

George S. Hays, general manager of the Fidelity division of the Long Bell Lumber Company, with headquarters at Doucette, Tex., has been transferred to Long View, Wash., as assistant to the general western manager.

N. E. Otterson has been transferred from the New York office of the Osgood Company and has been appointed district sales manager, with headquarters at Chicago, succeeding C. A. Phillips, who has resigned to engage in business.

L. D. Albin, general sales manager of the Ingersoll-Rand Company, 11 Broadway, New York City, has been elected vice-president in charge of European sales. Mr. Albin will be succeeded by **D. C. Keefe**, formerly assistant general sales manager.

Fred J. Mershon, export sales manager of the Industrial Works, has been placed in charge of the Detroit office, with headquarters in the Book building, Detroit, Mich. **L. A. Marshall**, service manager at Bay City, Mich., has been appointed sales engineer, with headquarters at Chicago. **C. D.**

Price, traveling service engineer, Bay City, Mich., has been appointed district sales manager, with headquarters in the Railway Exchange building, St. Louis, Mo.

H. P. Webb, Chemical building, St. Louis, Mo., has been appointed St. Louis representative of the Maintenance Engineering Corporation, Houston, Tex., manufacturer of the Davis tie tong.

J. L. Levay has joined the sales force at the Chicago office of the Browning Company, Cleveland, Ohio. **H. K. Robinson** has joined the Browning organization and will represent the company in its St. Louis territory, with headquarters at the company's offices, Federal Reserve Bank building, St. Louis, Mo.

John McKinnon, president and general manager of the Kalamazoo Railway Supply Company, Kalamazoo, Mich., who died suddenly on April 5, was born in Glasgow, Scotland, on October 3, 1851, and, arriving in America at the age of 20, was connected at various times with the Vulcan Iron Works, St. Louis, Mo.; Wabash Railway; Morden Frog & Switch Company, Chicago, of which he was general manager, and the Buda Company, Chicago, of which he was sales manager until 1905, when he entered the Kalamazoo Railway



John McKinnon



Frank E. McAllister

Supply Company as salesman. He was made secretary, general manager in January, 1907, and president and general manager in January, 1912. He was a life member of the Western Society of Engineers and in the past has been a director of the Track Supply Association and the National Railway Appliance Association. Following Mr. McKinnon's death, **Frank E. McAllister**, vice-president and general sales manager, has been elected president and general manager. Mr. McAllister has been connected with this company since February 7, 1910. On May 1, 1918, he was made general sales manager, and in January, 1921, was elected vice-president and general sales manager. He has been a director of the company since January, 1914. Also, following Mr. McKinnon's death, **Joseph E. Brown**, who has been a director of the company for a number of years, has been elected vice-president, while the other officers of the company remain the same as in the past, **D. A. Stewart**, being treasurer and engineer, and **W. N. Sidman**, secretary.

J. A. Turner, formerly purchasing agent of the Mobile & Ohio, has been appointed representative of the Fairmont Railway Motors, Inc., with headquarters in the Transportation building, Washington, D. C. **L. R. Payton** has been appointed representative, with headquarters in the Railway Exchange building, St. Louis, Mo.

E. A. Lundy, formerly business manager of Railway Signaling and Railway Electrical Engineer, publications associated with *Railway Engineering and Maintenance*, has resigned to organize the E. A. Lundy Company, with headquarters in the Union Trust Building, Pittsburgh, Pa., to take over certain sales and service of several companies in the railway field, including the Gibb Instrument Company, Bay City, Mich., and the Verona Tool Works, Verona, Pa. Mr. Lundy is a graduate of Pratt Institute, Brooklyn, N. Y.,

electrical engineering department. His first railroad experience was with the Atlantic Coast Line in the electrical department. From March, 1913, to September, 1916, he was engaged in various capacities on construction and maintenance work. From September, 1916, to June, 1918, he was connected with the signal department of the Long Island Railroad. He has also served in the Union Switch & Signal Company.

Elmer H. Smith, president of Smith's Inventions, Inc., and the Commercial Gas Company, has been elected president of the new Smith-Heylandt Company. **John R. R. Miles** is secretary. **Herman G. Anling** of Maywood, Ill., a former representative of the Heylandt Company, will co-operate with the new organization.

B. J. Wilson, formerly with the Simmons-Boardman Publishing Company at Chicago, has been appointed western representative of the Pocket List of Railroad Officials published by the Railway Equipment & Publication Company, New York. Mr. Wilson's headquarters are at 605 Fisher building, Chicago. He succeeds Leo Ehlbert.

Robert M. Horsey, for the past six years office manager of the order department of the National Lock Washer Company, Newark, N. J., died suddenly on May 12. Mr. Horsey entered the service of the National Lock Washer Company in 1912 and for six years served in the sales department. He was appointed manager of the order department and as office manager on December 1, 1918.

W. R. Toppan has been appointed manager of the newly created railroad department of the Conveyors Corporation of America, manufacturers of cinder and ash handling equipment, with headquarters at Chicago. Mr. Toppan was born at Newburyport, Mass., and entered the employ of the Galena Signal Oil Company in 1884 as a mechanical inspector, which position he held until 1901, being in charge of this company's service on the Atchison, Topeka & Santa Fe for the last three years of this period. He then entered the employ of the Kennicott Water Softener Company as manager of the railroad department, with headquarters at Chicago, which position he held until 1905, when he was promoted to general manager of that company.

In 1908 he was elected vice-president and general manager of the L. M. Booth Company, with headquarters at Chicago, which position he held until 1916, when he returned to the Kennicott Company as manager of the railroad department. In January, 1917, he entered the employ of the Graver Corporation as manager of the railroad department, with headquarters at Chicago, in which position he directed the sales of that company's water treating facilities to the railways until his resignation in March 1, 1924.

Irving A. Pfeil, of the Chicago office of the Blaw-Knox Company, has been appointed manager of the company's Detroit branch, succeeding Herbert J. Desson, who died on April 16 after a brief illness. Mr. Pfeil graduated in civil engineering at Ohio Northern University. During the World War he served as lieutenant in the aviation section. He has been with the Blaw-Knox Company since 1919.

G. A. Morrison, secretary and sales manager of the Bucyrus Company, Milwaukee, Wis., has been promoted to second vice-president in charge of sales in addition to his duties as secretary. **D. P. Eells**, treasurer and manager of the foreign and export departments, has been promoted to second vice-president in charge of the foreign and export departments in addition to his duties as treasurer. **William Bager**, chief engineer, has been promoted to second vice-president in charge of engineering.



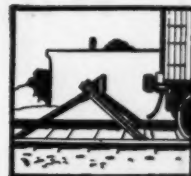
W. R. Toppan



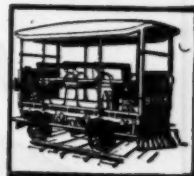
Crossing Gates



Electric Trucks



All-Steel Bumping Posts

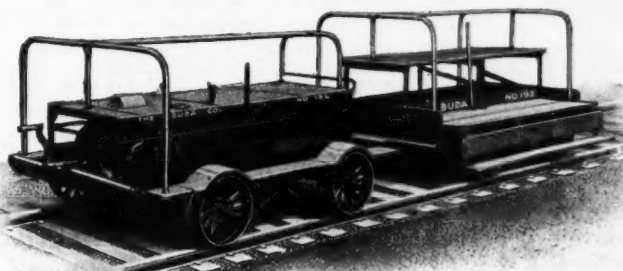


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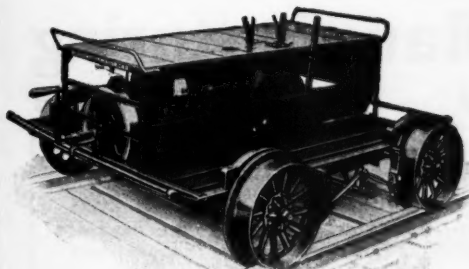
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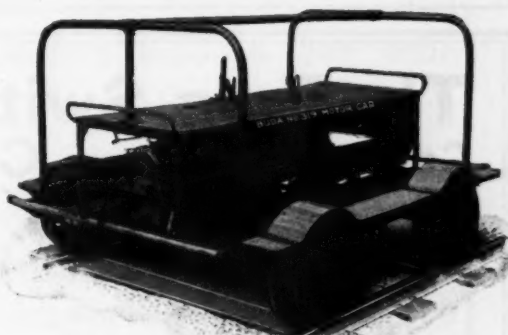
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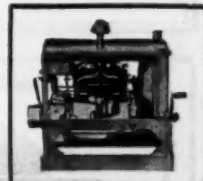
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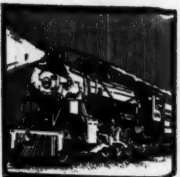
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May we tell you more about the Western Extension Floor or Apron with which any Western Automatic Air Dump Car can be equipped?



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Earth and Stone Handling Equipment
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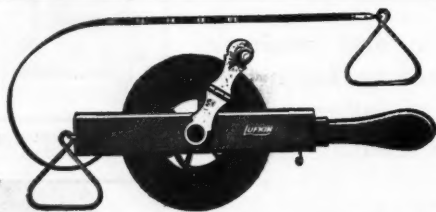
Established 1881

FROG AND SWITCH DEPARTMENT

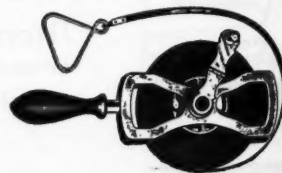
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One great trunk line road considers such economy so vital that it has adopted our chemical weeding method as standard practice, thereby saving \$23.56 per mile over its hand weeding costs.

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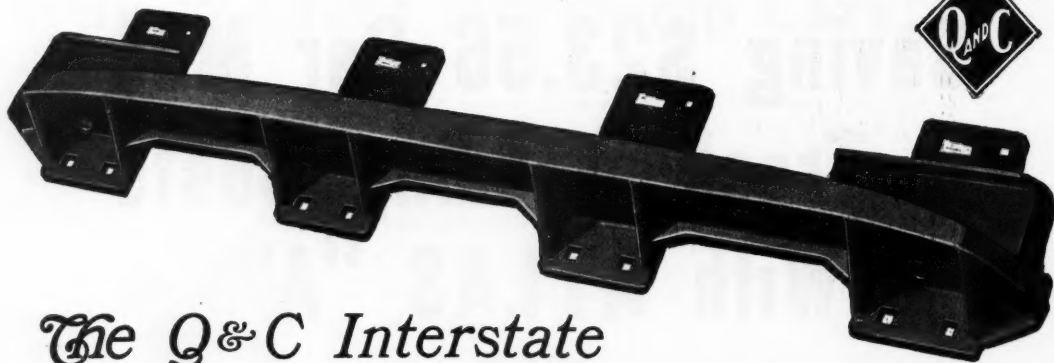
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MADE of tough, low carbon, annealed steel, thus eliminating brittleness and danger of breaking. The wearing face, however, of the Q & C Interstate One-Piece Guard Rail is toughened by a special process to a depth of about $1/2''$, and in strength and hardness is equivalent to manganese. There is ample space between the guard rail and the base of the running rail to prevent the accumulation of snow and ice. Spike holes on running rail side of guard rail are reinforced.

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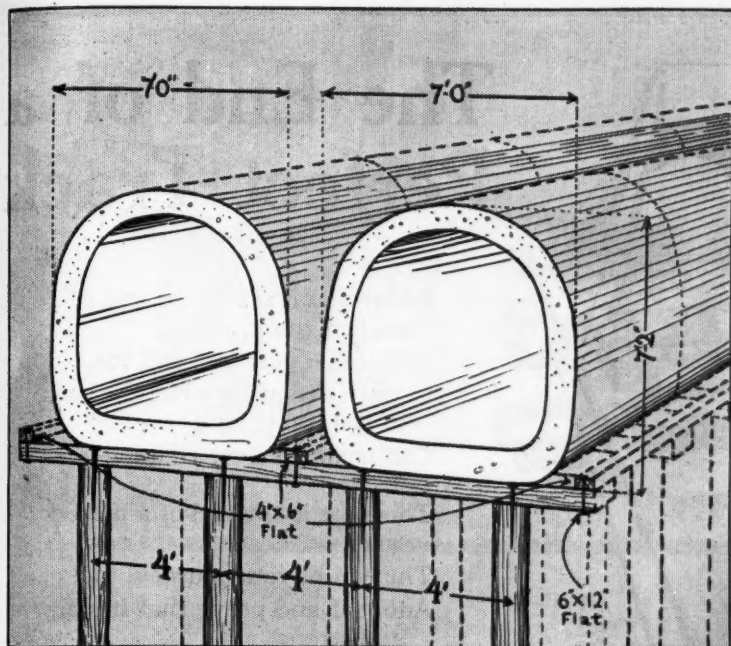
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Big Pipe— High Fill—

Massey Flat Base Precast Concrete Pipe

WHERE large pipe is to be laid under a high fill or in any other location where piling supports are advisable, the Massey flat base precast concrete pipe is particularly applicable.

The above illustrations show this pipe being installed on a large eastern road, and the general arrangement of piling supports. In this case, the ravine in which the pipe was laid was about 25 ft. deep, with a mud bottom 10 ft. to 20 ft. thick overlying gravel. Six 20-ft. piles were used under each 8-ft. section of pipe where the fill was the heaviest.

This flat base pipe is manufactured only in the 68 in. by 68 in. size. The design has been carefully worked out by the Massey engineers from their long experience in building and laying precast concrete pipe. Ample provision is made

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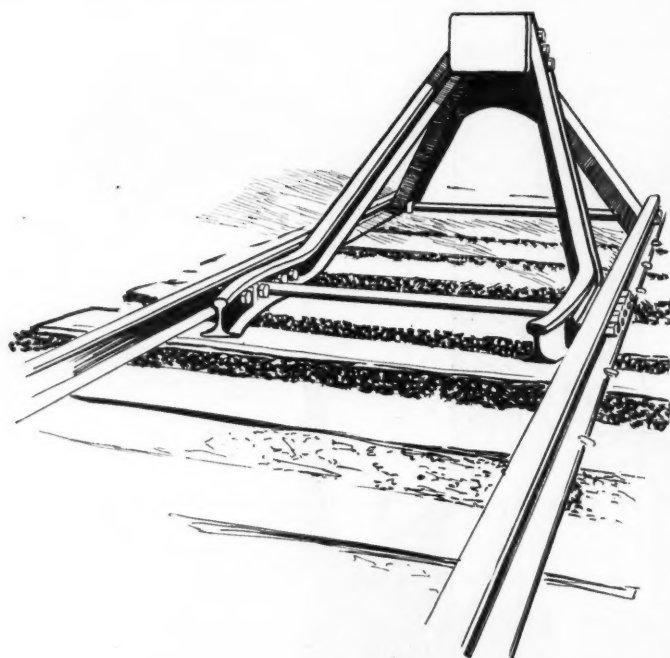
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(With All Necessary Apologies)

When you come to the end of a perfect track,
A Durable post you will see,
If you've thought what the lack of a suitable post
Can mean to a car running free.

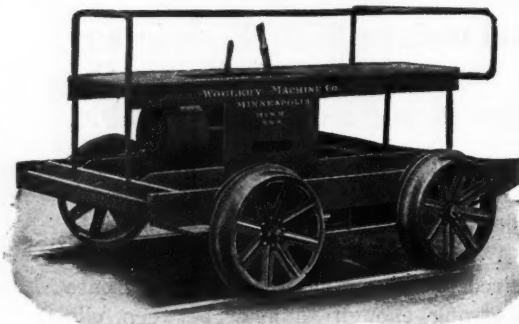
This post is the end of a perfect track,
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Adopt it and prove that it's big and strong,
You'll find it a friend true blue.

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You not only get *reliable* power, but *economical* power, and at low final cost.

Years of railway service records, repair shop cost comparisons and power tests show their low fuel consumption, dependability, long life and exceptional power in proportion to their weight and rating.

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Costs Less!**

Write nearest office for booklet R, names of railway users, and prices.

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McWANE



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Bell and Spigot Type

How many of your water columns are knocked down every year?

What does the repairs and maintenance—not the result of ordinary use—cost you?

Avoid this annoyance, trouble and expense by using a

How lateral movement of spout prevents column being knocked down

POAGE Style "H" WATER COLUMN with FENNER DROP SPOUT

The three foot lateral range in the Fenner spout and the steel riser in the Poage Style H save the water column from being knocked down by the shifting of the tender.

The tender has to leave the track to knock this column down.

The flexible spout makes it unnecessary to spot the tender accurately. You save time by quick adjustment.

The five foot up and down range enables the water column to fill a tender of any height.

Manufactured Exclusively By

The American Valve & Meter Co.

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The open telescopic joint does not waste a drop of water. It banishes the usual winter time troubles. Ice does not collect upon it.

The valve permits the maximum amount of water to flow in the shortest time. There is a minimum of frictional resistance. It shuts the water off quick without water hammer.

Try the Poage Style H column. You will find that it has remarkable operating advantages.



40,000 Gallons Per Day For Four Years

That is the record of this Sullivan Air Lift at Telford, Pa., on the Philadelphia & Reading.

The plant includes one well, track tank, a Sullivan Air Lift pump, relift booster, and Sullivan single stage, short-belt (motor) drive air compressor, with stop and start control.

The station agent, 3,600 feet away, presses a button to stop or start pumping. The tank is 536 feet from the well house.

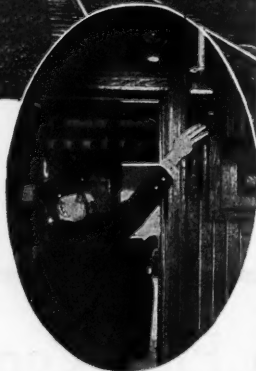
This little plant is automatic, save for an occasional track-walker's visit to fill the lubricators. It is furnishing the same amount of water per minute as when installed in 1920.

Described in "Mine & Quarry" No. 1940.

Bulletin 1971-D

Sullivan Machinery Company

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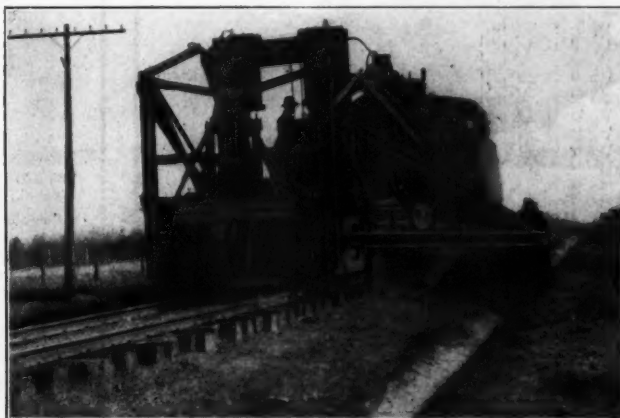
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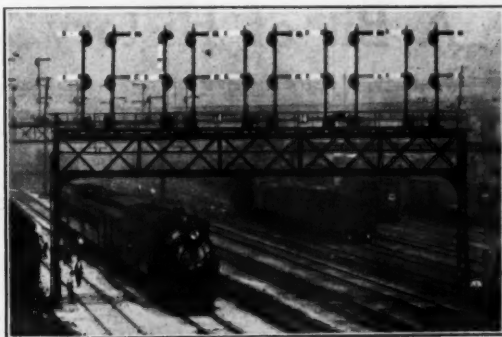
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When track insulation stops *insulating*, it demands quick action.

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For special purposes, where exceptionally high electrical properties are essential, Celoron is the ideal material.

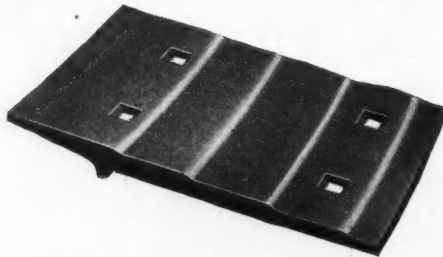
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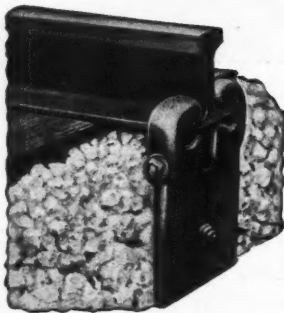
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Will give rail and wheels longer life.
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Will hold in both directions.

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AMERICAN WATER SOFTENERS are saving thousands of dollars each year on the twenty-nine American Railroads who have, during these twenty-two years of our existence, realized the advantages of softening hard feed water supplies in AMERICAN LIME-SODA WATER SOFTENERS.

We can help you solve your problem, if you will write us.

AMERICAN WATER SOFTENER COMPANY
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Specialists for twenty-two years in
RAILROAD WATER PURIFICATION

Are You Going to Get Your Share?

In 1923, the railroads spent over one billion dollars for improvements in their properties in addition to equally liberal expenditures for maintenance. Roughly speaking, two-thirds of the total expenditures went for equipment and one-third for roadway and structures.

During 1924, present prospects indicate that these percentages may be reversed—at least to the extent that greatly increased expenditures will be made for additions and improvements to the tracks and structures.

THE REASON IS OBVIOUS

In 1923 the roads were confronted with what might easily have become an excess of traffic. Cars and motive power were the immediate necessity. Every dollar that could safely be so expended went for equipment. Construction and maintenance of way expenditures, while liberal, were secondary to equipment. Many improvements waited.

In 1924 a very heavy traffic will still be within the present enlarged equipment capacity of the roads to handle it. But it must be handled within narrower limits of expense per ton mile and per train mile. This means a greater proportionate expenditure for maintenance of way and roadway betterment. "Reduce Operating Costs" is the slogan for 1924.

Traffic is now heavier than last year and though not so heavy during the first few weeks of the year the record of car loading is now better than ever before. This means increased wear and tear on roadway and track, increased expenditures to take care of wear and tear and increased earnings to take care of the expenditures.

A FEW PERTINENT FACTS

From budgets already prepared it is shown that one road is planning to expend \$70,000,000 in improvements. Another has set aside \$50,000,000, and two others have plans calling for \$40,000,000 each; while the estimates of several roads call for expenditures of from \$12,000,000 to \$18,000,000. These are only a few of the larger items.

These plans include a large amount of second and other multiple track, the enlargement of terminal facilities, etc., which will require large tonnages of rails, joints, tie plates and other track accessories, as well as the tools and appliances for doing the work. Other improvements will require other materials and supplies in similar proportions.

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Its pages afford the medium through which to make known your products which will necessarily be in demand.

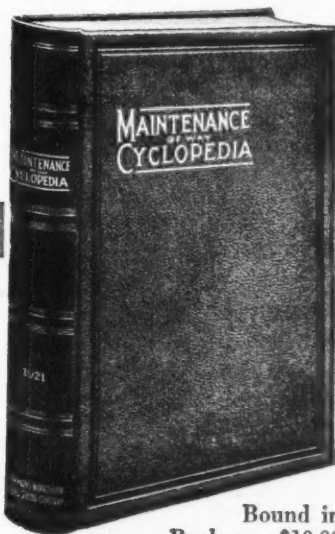
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608 So. Dearborn St., Chicago.

Are You Going to Do Your Share?

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But there are other questions that, through lack of space or your own lack of time, go unanswered. There are facts and figures which you may know perfectly, but about which you hesitate to trust your memory. It is for clear explanation and helpful illustration of these complex facts and figures that you need

Maintenance of Way Cyclopedia

Compiled and Edited by

E. T. HOWSON, Western Editor of the *Railway Age*, and Editor of *Railway Engineering and Maintenance*.

E. R. LEWIS, Formerly Chief Engineer of the Duluth, South Shore & Atlantic R. R.

K. E. KELLENBERGER (Signal Section), Editor of *Railway Signaling*.

Assisted by

HOMER HUGHES, Associate Editor, Formerly Assistant Field Engineer, Interstate Commerce Commission.

in co-operation with the

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 "How to use this card."

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 of
 Maintenance
 of Way
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There are
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 with more
 than 2,500
 illustrations.

Ballast Crusher



Harro-Moff Ballast Screen
The Maintenance Equipment Co.
(See Page 22)

by power to the extent of portable crushing machines. Sometimes a car fitted with automatic toothed rakes on each side is used to stir up the top ballast on the shoulders outside the ends of the run.

BALLAST CRUSHER. A machine designed to crush or break down and breakers to use suitable for ballasting tracks. Extensive rock crushing plants commonly have large crushers for producing 4 in. to 6 in. stone from large rock or boulders, and smaller machines to crush this material to particles ranging from 1/4 in. to 2 1/2 in. in size suitable for ballast. See Rock Crusher (General Section).

BALLAST, DISINTEGRATED ROCK. A natural deposit of fragmentary rock, usually granite, but sometimes a quartz formation which is quarried and used as ballast in a few localities on some American and foreign railways. It breaks in pieces convenient for ballast when loaded to insure it from its bed or is easily broken along lines of natural cleavage to the proper size. The particles are hard, heavy, inert and difficult to handle as ballast, but pack down and hold track well.

BALLAST FORK. A tool similar to a loading fork, but with a wider spread of tines and longer tines, designed for handling crushed stone and for clearing crushed stone ballast of dirt accumulated

TRACK SECTION

which are square in section, tapering toward the four ends and attached to a steel shoulder which curves upward at each side to retain the back of the load on the inner side to the handle, which is curved to the front in a long strap ferrule. The spaces between the tines, limited to suit the ballast, are usually about 1 in. to 1 1/4 in. wide.

BALLAST GRAVEL. A mixture of rock, (consisting of natural deposits) that will pass through a 2 1/2 in. ring and be retained on a No. 10 screen (A. R. E. A.).

This ballast is valued above all kinds except crushed rock. It is usually composed of hard particles worn smooth and round by glacial processes, being inferior to rock only because its rounded particles do not bind together so readily as the sharp-edge stone.

Gravel is the most readily available and widely used of all ballast materials. It occurs in extensive



Typical Gravel Ballast Track

glacial beds, sometimes in high ridges several miles in length, but often in smaller bodies underlying level ground. It occurs commonly in areas alternating with layers of sand and boulders with which materials it is usually more or less mixed. Discrete portions of gravel ballast in free from clay and hum, but may contain from 25 per cent to 50 per cent of clean sand, mixed with gravel particles which will pass a 2 1/2 in. ring. Gravel particles and boulders are less abundant than in areas of sand and are the presence of clay or hum, for boulders may be used and, likewise, are crushed for ballast or for other maintenance purposes. Discrete gravel ballast pits are those which are convenient to the tracks to be ballasted, easily drained, of sufficient depth to enable the material to be loaded by steam shovel or similar equipment and of sufficient area to warrant the installation of adequate storage, passing and repair tracks of suitable strength, as well as room for the disposal of surplus gravel and boulders. For economical excavation for stone gravel the material should be close to the surface in level areas not less than 6 ft. deep.

The Track Section—

Track laying methods and appliances as well as those used in maintenance work are described and defined in this section of **Maintenance of Way Cyclopedia**. Hundreds of drawings, photographs, and sixteen large folding plates are included.

Bridges?

Types of bridges and methods used in their construction are described and illustrated in the Bridge Section. A. R. E. A. specifications for bridge design and erection are given.

Buildings?

In the Buildings Section, various types of railway buildings—passenger stations, coaling stations, engine and freight houses, etc.—are described and illustrated by photographs and drawings.

Water Service?

Appliances and tools needed for water service work are described and pictured in the Water Service Section. American Water Works Association and American Society for Testing Materials pipe specifications are given.

Wood Preservation?

The subject is treated fully, from a practical standpoint, in its own section, which includes a key for the identification of woods, and specifications for different preservative treatments.

Signals?

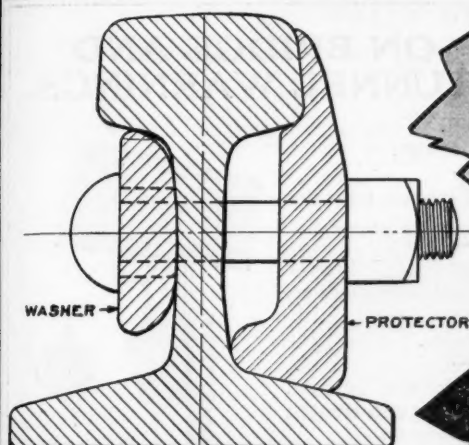
Principles and apparatus used in modern railway signaling are thoroughly covered in the 120-page Signal Section. A. R. A. requisites of installation and R. S. A. specifications are included.

General Information?

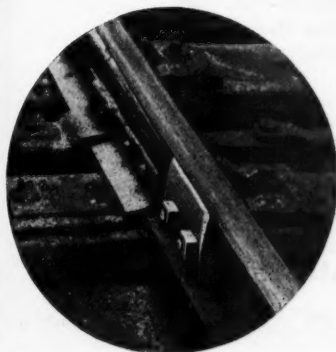
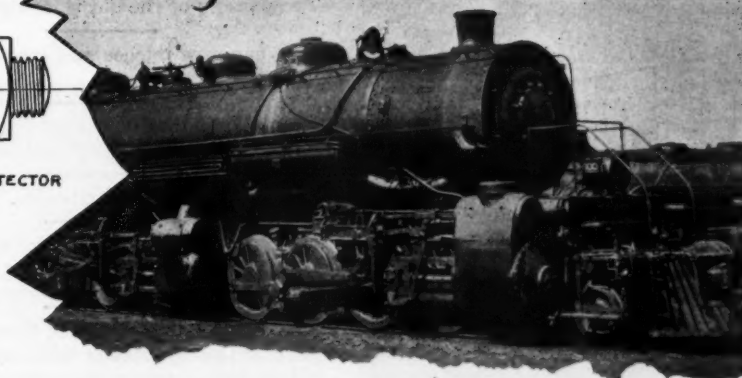
Information regarding construction and camp equipment, as well as tools and devices used in foregoing sections, general specifications, etc., will be found in the General Section.

Catalog Data?

Machines and appliances used in every branch of maintenance are specifically described, in a Catalog Section, together with readily accessible information as to where they may be obtained.



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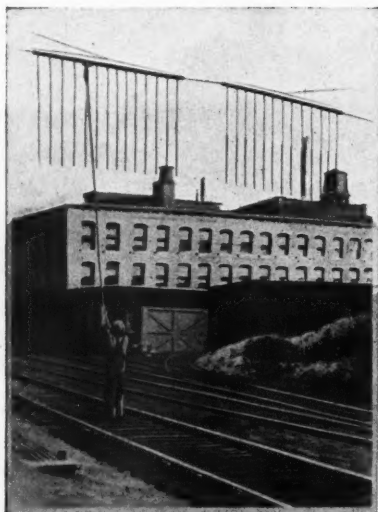
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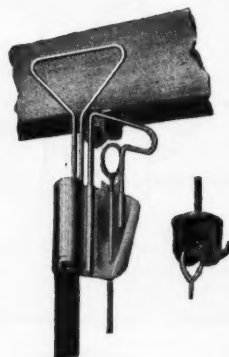
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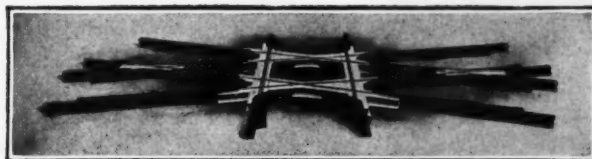
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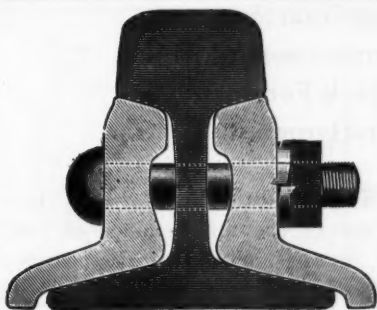
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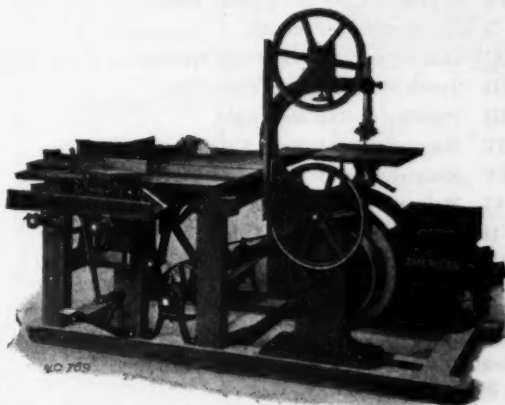
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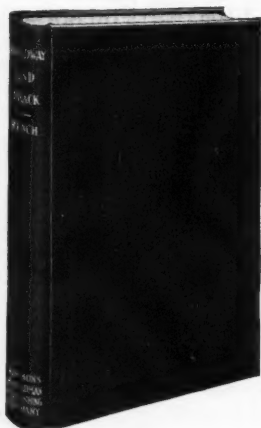
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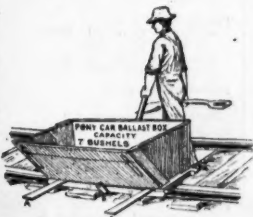
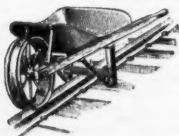
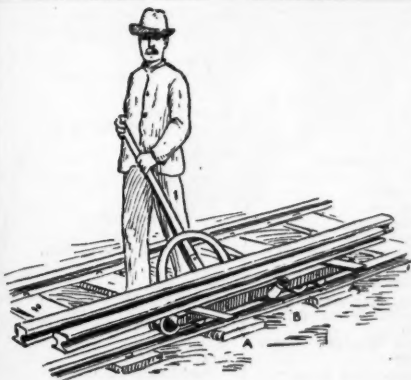
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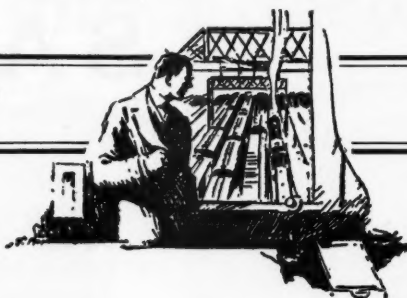
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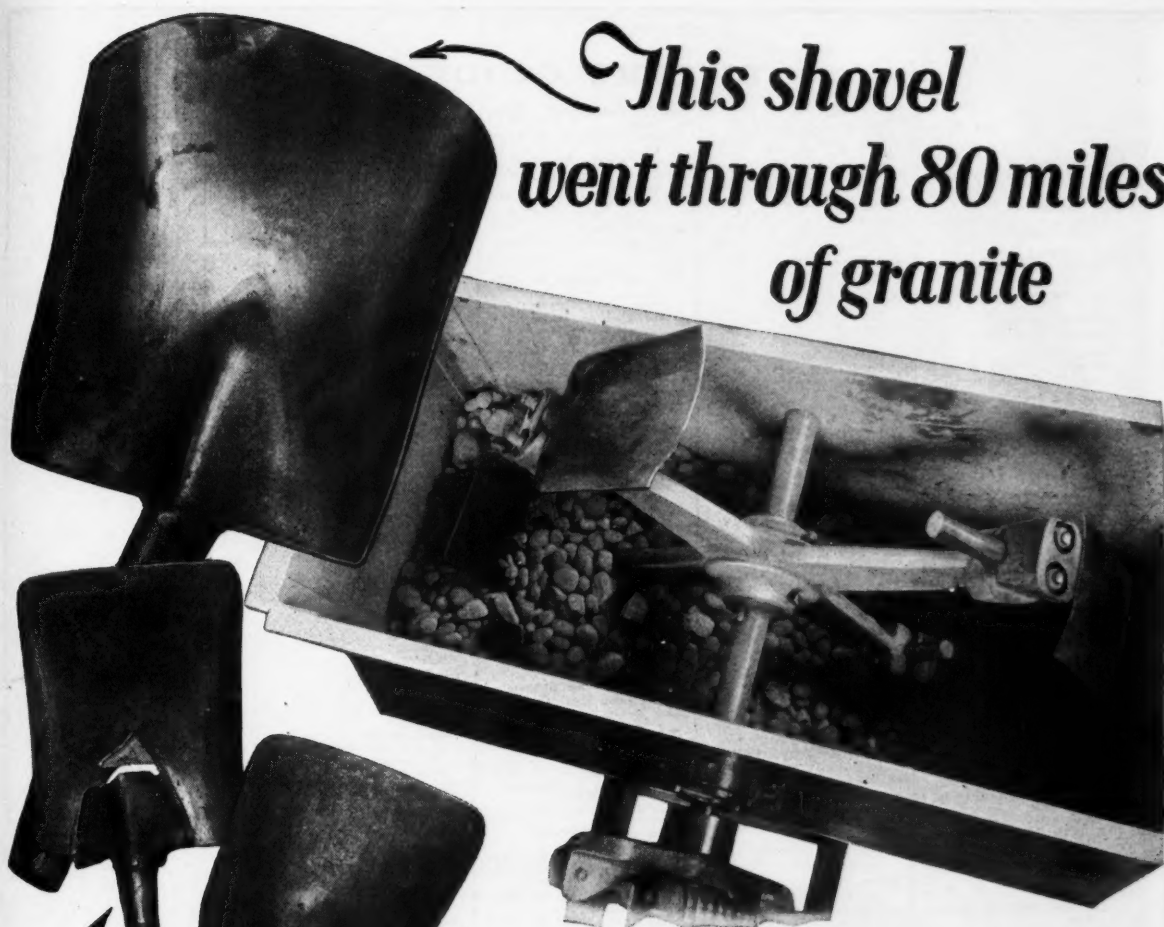
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Mo-lyb-den-um was chosen. With it, countless experiments were made—extending over a period of years. Many tests failed. Each, however, added something to the knowledge of how to treat Mo-lyb-den-um steel. Finally a method was originated which produced a steel far superior to anything that had ever before been used.

This is the steel which is used in Wood's Mo-lyb-den-um Shovels to-day. Its supremacy is recognized. Attempts to imitate it are doomed to failure because it is made by a secret process—and this process is responsible for the wonderful

qualities which are making Wood's Mo-lyb-den-um Shovels famous. Other manufacturers can make a Mo-lyb-den-um Steel Shovel, but they cannot make a *Wood's* Mo-lyb-den-um Shovel.

Not satisfied with perfecting the steel, this company next turned its attention to other shovel improvements. Notably, the step, or turned-over edge—which makes the shovel easier on the feet, and at the same time adds strength to the blade. And then the Moly-D handle—acclaimed the greatest handle improvement ever invented.

Wood's Mo-lyb-den-um Shovels last from two to six times longer than any other shovels made. Write to-day for full information on the application of these shovels to all your needs.

THE WOOD SHOVEL & TOOL CO.
Piqua, Ohio, U. S. A.

*These Shovels
DID NOT*

stand one-fifth the wear and tear that Wood's Mo-lyb-den-um Shovels did. They were put completely out of commission after lifting approximately 700 tons. And they represent the highest grade shovels of their respective makers. Wood's Mo-lyb-den-um Shovels lifted 3485 tons, and are still ready for more service.




Wood's Mo-lyb-den-um Shovels
—The American Super Steel—

BUYERS' GUIDE

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| Pipe, Cast Iron. McWane Cast Iron Pipe Co. | Rail Braces. Bethlehem Steel Co. Buda Co. Q. & C. Co. Ramapo Ajax Corp. Wharton Jr. & Co., Wm. | Signal Foundations, Concrete. Massey Concrete Products Corp. | Tampers, Tie. Ingersoll-Rand Co. | Track Tools. Buda Co. Q. & C. Co. Verona Tool Works. |
| Pipe, Concrete. Massey Concrete Products Co. | Rail Joints. Bethlehem Steel Co. Q. & C. Co. Rail Joint Co. Wharton Jr. & Co., Wm. | Signals, Bridge Warning. Hastings Signal & Equipment Co. Skid Shoes. Q. & C. Co. | Tanks, Water Storage. Chicago Bridge & Iron Works | Transfer Tables. Industrial Works. |
| Pipe, Corrugated. Armco Culvert & Flume Mfrs. Assn. | Rail Saws, Portable. Industrial Works. Q. & C. Co. Verona Tool Works. | Slabs, Concrete. Massey Concrete Products Corp. | Tanks, Elevated Steel. Chicago Bridge & Iron Works | Treating Plants, Water. American Water Softener Co. |
| Pipe Carriers. Massey Concrete Products Corp. | Rail Springs. Verona Tool Works. | Smoke Stacks. Chicago Bridge & Iron Works. Massey Concrete Products Corp. | Tanks, Oil Storage. Chicago Bridge & Iron Works | Trestle Slabs. Massey Concrete Products Corp. |
| Pipe Joint and Compound. Dixon Crucible Co., Jos. | Red Lead. Eagle Picher Lead Co. | Snow Melting Devices. Q. & C. Co. | Tank Valves. American Valve & Meter Co. | Tunnel Warnings. Hastings Signal & Equipment Co. |
| Platforms, Station. Headley Good Roads Co. | Removers, Paint and Varnish. Eagle Picher Lead Co. Mudge & Co. | Snow Plows. Jordan Co., O. F. Q. & C. Co. | Tapes. Lufkin Rule Co. | Vacuum Pumps. American Well Works. Goulds Mfg. Co. Ingersoll-Rand Co. Sullivan Machinery Co. |
| Plows, Railroad. Western Wheeled Scraper Co. | Replacers, Car. Buda Co. Q. & C. Co. | Spikes. Bethlehem Steel Co. | Telephone Booths. Massey Concrete Products Corp. | Ventilators. Q. & C. Co. |
| Pneumatic Tools. Ingersoll-Rand Co. | Riveting Hammers. Ingersoll-Rand Co. Sullivan Machinery Co. Verona Tool Works. | Sprayers. Jordan Co., O. F. Western Wheeled Scraper Co. | Tell-tales. Hastings Signal & Equipment Co. | Warning Devices — Bridge and Tunnel. Hastings Signal & Equipment Co. |
| Poles. International Creosoting & Construction Co. Massey Concrete Products Corp. | Rivets. Bethlehem Steel Co. | Standpipes. Chicago Bridge & Iron Works. | Tie Plates. Bethlehem Steel Co. Lundie Engineering Corp. | Washers, Fibre. Diamond State Fibre Co. |
| Pony Car. American Trackbarrow Co. | Rock Drills. Ingersoll-Rand Co. Sullivan Machinery Co. Verona Tool Works. | Standpipes (Penstock). American Valve & Meter Co. | Tie Rods. Bethlehem Steel Co. | Water Column. American Valve & Meter Co. |
| Posts, Fence. Q. & C. Co. | Roller Bearings. Hyatt Roller Bearing Co. | Stands, Switch and Target. Bethlehem Steel Co. Q. & C. Co. Ramapo Ajax Corp. | Tie Tamper. Ingersoll-Rand Co. | Water Crane. American Valve & Meter Co. |
| Posts, Bumping. Buda Co. Mechanical Mfg. Co. | Roof Slabs. Massey Concrete Products Corp. | Station Houses. Massey Concrete Products Corp. | Tie Tongs. Maintenance Engineering Corp. | Water Softening Plants. American Water Softener Co. |
| Powders. DuPont de Nemours & Co., E. I. | Roofing Composition. Lehon Co. | Steel Forms. Blaw-Knox Co. | Timber, Creosoted. International Creosoting & Construction Co. | Water Treating Plants. American Water Softener Co. |
| Power Houses. Massey Concrete Products Corp. | Rules. Lufkin Rule Co. | Steel Plates and Shapes. Bethlehem Steel Co. | Tool Steel. Bethlehem Steel Co. | Water Tanks. Chicago Bridge & Iron Works. |
| Preservation, Timber. International Creosoting & Construction Co. | Saw Mills. American Saw Mill Machinery Co. | Step Joints. Q. & C. Co. Rail Joint Co. | Tools, Working. Industrial Works. | Water Treating Tanks. Chicago Bridge & Iron Works. |
| Pumps, Air Pressure and Vacuum, Centrifugal, Deep Well, Piston, Plunger, Rotary, Sump. American Well Works. Goulds Mfg. Co. Ingersoll-Rand Co. Sullivan Machinery Co. | Saws, High Speed Friction. American Saw Mill Machinery Co. | Storage Tanks. Chicago Bridge & Iron Works. | Tongue Switches. Bethlehem Steel Co. Buda Co. | Waterproofing Fabrics. Lehon Co. |
| Push Car Bearings. Hyatt Roller Bearing Co. | Saws, Portable Rail. Industrial Works. Q. & C. Co. | Structural Steel. Bethlehem Steel Co. Buda Co. | Tools, Switching. Industrial Works. | Wood Killer. Chipman Chemical Engineering Co., Inc. |
| Push Cars. Buda Co. Fairmont Railway Motors, Inc. Mudge & Co. Woolery Machine Co. | Saw Rigs. American Saw Mill Machinery Co. | Frog Switch & Mfg. Co. Kilby Frog & Switch Co. Ramapo Ajax Corp. Wharton Jr. & Co., Wm. | Tools, Switching. Bethlehem Steel Co. Buda Co. | Wood Preservation. International Creosoting & Construction Co. |
| Rails. Bethlehem Steel Co. | Scales. Lufkin Rule Co. | Switch Locks. American Valve & Meter Co. | Tools, Switching. Bethlehem Steel Co. Buda Co. | Woodworking Machinery. American Saw Mill Machinery Co. |
| Rail Anchors. Lundie Engineering Corp. | Scrapers, Wheel, Drag and Buck. Western Wheeled Scraper Co. | Switchmen's Houses. Massey Concrete Products Corp. | Tools, Switching. Bethlehem Steel Co. Buda Co. | Wrecking Cranes. Industrial Works. |
| Rail Anti-Creepers. Lundie Engineering Corp. | Screw Spike Drivers. Ingersoll-Rand Co. | Switchpoint Protectors. Fleming & Sons Co., Inc. J. E. | Tools, Switching. Bethlehem Steel Co. Buda Co. | Wrecking Tools. Industrial Works. |
| Rail Benders. Buda Co. Q. & C. Co. | Sheet Fibre. Diamond State Fibre Co. | Switchstands and Fixtures. American Valve & Meter Co. Bethlehem Steel Co. Buda Co. | Tools, Switching. Bethlehem Steel Co. Buda Co. | |
| Rail Bond. Verona Tool Works. | Sheet Iron. Armco Culvert & Flume Mfrs. Assn. | Switchstands and Fixtures. American Valve & Meter Co. Bethlehem Steel Co. Buda Co. | Tools, Switching. Bethlehem Steel Co. Buda Co. | |
| | Shingles, Composition. Lehon Co. | Switchstands and Fixtures. American Valve & Meter Co. Bethlehem Steel Co. Buda Co. | Tools, Switching. Bethlehem Steel Co. Buda Co. | |

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MAINTAINING the bolted security
and rigidity of railway track joints
can only be accomplished through an
active, non-flattenable spring member.

The National Lock Washer Co.
Newark, N. J., U. S. A.

IMPROVED
HIPOWER

Take a Wrench and see for yourself



WHETHER your track bolts are tight or loose is not a question for argument—it is a matter of fact.

Our statement that your bolts are loose does not make them loose. Your statement that your bolts are tight does not make them tight. But upon that question of fact, you will have to make many important decisions. If your bolts are loose, you certainly ought to know it, and there is only one way you can really learn.

Take a wrench and see for yourself.

Walk a mile of track and draw up loose bolts wherever you find them. Then ride twenty or thirty miles and try again. "Sample" your track thus at intervals and you will soon be in possession of the facts.

One thing more: Every time you find a loose bolt say to yourself, "This bolt was tight once. Stretch or rust or wear has made it loose. My wrench will make it tight again; but a Verona Rail Joint Spring, by compensating for stretch or rust or wear, would have *kept* it tight."

VERONA TOOL WORKS

Pittsburgh New York Chicago Boston St. Louis
San Francisco New Orleans Montreal Washington

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